Appendix C: Climate Change Effects Typology Matrix

1 The Climate Change Effects Typology Matrix

Global					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
		2040-2070			
Temperature increase (mean annual)	Global	1.37 degrees Celsuis (C) by 2045 (5%) 1.85 degrees C by 2045 (Median) 2.37 degrees C by 2045 (95%)	Very likely;	MIT Integrated Global System Model; Uses the Emissions Prediction and Policy Analysis Model (EPPA), a general equilibrium model of the world economy, for estimating future emissions	Sokolov et al. (2009)
Temperature increase (mean annual)	Global	0.57 degrees C by 2045 (5%) 1.34 degrees C by 2045 (Median) 1.80 degrees C by 2045 (95%)	Very likely; 40% probability of SAT increasing by less than 2 degrees C by the end of 21st century relative to 1990 for the "business-as-usual" emissions scenario	MIT Integrated Global System Model; Uses the Emissions Prediction and Policy Analysis Model (EPPA), a general equilibrium model of the world economy, for estimating future emissions	Webster at al. (2003) as cited in Sokolov et al. (2009)
Sea level rise (total)	Global	+5 inches (in) global sea-level rise by mid-century (2040-2060)	Not provided	B1 scenario, sea-level rise is relative to 2005	IPCC (2007) Summary for Policy Makers, as cited in Frumhoff et al. (2007)

Global					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Sea level rise (total)	Global	+5 to 10 in global sea-level rise by mid-century (2040-2060)	Not provided	A1FI scenario, sea-level rise is relative to 2005; Low bound is from IPCC (2007) Summary for Policymakers high bound is from Rahmstorf (2007)	Frumhoff et al. (2007)
Sea level rise (total)	Global	+0.09 meter (m) by 2040-2060	Not provided	B1 emissions scenario, relative to the mean sea level change calculated from a 200-year control run	Meehl et al. 2006
Sea level rise (total)	Global	+0.12 m by 2040-2060	Not provided	A2 (higher) and A1B (moderate) emissions scenarios, relative to the mean sea level change calculated from a 200-year control run	Meehl et al. 2006
Sea level rise (total)	Global	10 centimeter (cm) by 2045 (5%) 14 cm by 2045 (Median) 18 cm by 2045 (95%)	Very likely;	MIT Integrated Global System Model; Uses the Emissions Prediction and Policy Analysis Model (EPPA), a general equilibrium model of the world economy, for estimating future emissions	Sokolov et al. (2009)
Sea level rise (total)	Global	6 cm by 2045 (5%) 10 cm by 2045 (Median) 14 cm by 2045 (95%)	Very likely;	MIT Integrated Global System Model; Uses the Emissions Prediction and Policy Analysis Model (EPPA), a general equilibrium model of the world economy, for estimating future emissions	Webster at al. (2003) as cited in Sokolov et al. (2009)
Sea level rise (thermosteric)	Global	3 cm by 2045 (5%) 6 cm by 2045 (Median) 12 cm by 2045 (95%)	Very likely;	MIT Integrated Global System Model; Uses the Emissions Prediction and Policy Analysis Model (EPPA), a general equilibrium model of the world economy, for estimating future emissions	Webster at al. (2003) as cited in Sokolov et al. (2009)

Global					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
		2070-2100			
Temperature increase (mean annual)	Global	3.50 degrees C by 2095 (5%) 5.12 degrees C by 2095 (Median) 7.37 degrees C by 2095 (95%)	Very likely;	MIT Integrated Global System Model; Uses the Emissions Prediction and Policy Analysis Model (EPPA), a general equilibrium model of the world economy, for estimating future emissions	Sokolov et al. (2009)
Temperature increase (mean annual)	Global	1.03 degrees C by 2095 (5%) 2.37 degrees C by 2095 (Median) 4.61 degrees C by 2095 (95%)	Very likely;	MIT Integrated Global System Model; Uses the Emissions Prediction and Policy Analysis Model (EPPA), a general equilibrium model of the world economy, for estimating future emissions	Webster at al. (2003) as cited in Sokolov et al. (2009)
Storm events	Not provided	The warming resulting from a doubling of CO2 will cause the potential intensity of tropical cyclones to remain the same or increase by 10 to 20%	Not provided	Doubling of CO2 scenario	Henderson-Sellers et al. (1998) as cited in SAP 3.3 (CCSP, 2008)
Storm events	Not provided	See Figure 3.8 on p. 107 of SAP 3.3 - For a CO2-induced tropical SST warming of 1.75 degrees C, they found a 14% increase in central pressure fall and a 6% increase in maximum surface wind or a maximum wind speed sensitivity of about 4% per degree C	Not provided	Scenario - present-day conditions; high CO2 conditions (after an 80-year warming trend in a +1% per year CO2 experiment	Knutson and Tuleya (2004) as cited in SAP 3.3 (CCSP, 2008)
Sea level rise (total)	Global	+9 in global sea-level rise by late-century (2080-2100)	Not provided	B1 scenario, sea-level rise is relative to 2005	Frumhoff et al. (2007)

Global					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Sea level rise (total)	Global	+12 to 35 in global sea-level rise by late-century (2080-2100)	Not provided	A1FI scenario, sea-level rise is relative to 2005; Low bound is from IPCC (2007) Summary for Policymakers high bound is from Rahmstorf (2007)	Frumhoff et al. (2007)
Sea level rise (total)	Global	0.5 to 1.4 m (1.6 to 4.6 feet (ft)) by 2100 compared to 1990 levels	Not provided	Empirical approach uses a proportionality constant of 3.4 mm/yr per degree Celsius; thereby assumes no tipping points are reached, nor takes into account any changes in ocean circulation	Rahmstorf (2007)
Sea level rise (total)	Global	+0.18 - 0.38 m by 2090-2100	Not provided; Range based on climate models excluding rapid dynamic changes in ice flow.	B1 scenario; sea level rise is relative to 1980-1999	IPCC (2007) as cited by US CCSP (2008) Gulf Coast study: in Table 3.1 on page 3T-1
Sea level rise (total)	Global	+0.20 - 0.45 m by 2090-2100	Not provided; Range based on climate models excluding rapid dynamic changes in ice flow.	A1T scenario; sea level rise is relative to 1980-1999	IPCC (2007) as cited by US CCSP (2008) Gulf Coast study: in Table 3.1 on page 3T-1

Global					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Sea level rise (total)	Global	+0.20 - 0.43 m by 2090-2100	Not provided; Range based on climate models excluding rapid dynamic changes in ice flow.	B2 scenario; sea level rise is relative to 1980-1999	IPCC (2007) as cited by US CCSP (2008) Gulf Coast study: in Table 3.1 on page 3T-1
Sea level rise (total)	Global	+0.21 - 0.48 m by 2090-2100	Not provided; Range based on climate models excluding rapid dynamic changes in ice flow.	A1B scenario; sea level rise is relative to 1980-1999	IPCC (2007) as cited by US CCSP (2008) Gulf Coast study: in Table 3.1 on page 3T-1
Sea level rise (total)	Global	+0.23 - 0.51 m by 2090-2100	Not provided; Range based on climate models excluding rapid dynamic changes in ice flow.	A2 scenario; sea level rise is relative to 1980-1999	IPCC (2007) as cited by US CCSP (2008) Gulf Coast study: in Table 3.1 on page 3T-1
Sea level rise (total)	Global	+0.26 - 0.59 m by 2090-2100	Not provided; Range based on climate models excluding rapid dynamic changes in ice flow.	A1F1 scenario; sea level rise is relative to 1980-1999	IPCC (2007) as cited by US CCSP (2008) Gulf Coast study: in Table 3.1 on page 3T-1

Global					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Sea level rise (total)	Global	+0.15 m by 2090-2100	Not provided	B1 emissions scenario, relative to the mean sea level change calculated from a 200-year control run	Meehl et al. 2006:
Sea level rise (total)	Global	+0.23 m by 2090-2100	Not provided	A1B emissions scenario, relative to the mean sea level change calculated from a 200-year control run	Meehl et al. 2006:
Sea level rise (total)	Global	+0.28 m by 2090-2100	Not provided	A2 emissions scenario, relative to the mean sea level change calculated from a 200-year control run	Meehl et al. 2006:
Sea level rise (total)	Global	Estimates of sea-level rise for a global temperature increase between 1.1 and 6.4 degrees C (the IPCC estimate of likely temperature increases by 2100) are about 7 to 23 in (0.18 to 0.59 m)	Not provided	Scenario not provided	IPCC (2007) as cited in SAP 4.6 (CCSP, 2008)
Sea level rise (total)	Global	29 cm by 2095 (5%) 44 cm by 2095 (Median) 63 cm by 2095 (95%)	Very likely;	MIT Integrated Global System Model; Uses the Emissions Prediction and Policy Analysis Model (EPPA), a general equilibrium model of the world economy, for estimating future emissions	Sokolov et al. (2009)
Sea level rise (total)	Global	15 cm by 2095 (5%) 29 cm by 2095 (Median) 50 cm by 2095 (95%)	Very likely;	MIT Integrated Global System Model; Uses the Emissions Prediction and Policy Analysis Model (EPPA), a general equilibrium model of the world economy, for estimating future emissions	Webster at al. (2003) as cited in Sokolov et al. (2009)

Global					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Sea level rise (total)	Global	0.8 to 2.0 m by 2100	Not provided	This study estimates SLR projections using three SLR scenarios (low to high) to obtain values for the dynamic discharge in varying the outlet glacier velocities and discharge for Greenland, Antarctic-Peninsula, glaciers and ice caps. The eustatic contributions to SLR from surface mass balance losses and discharge of ice into the ocean through marine-terminating glaciers is calculated based on a scaled ratio and the thermal expansion is based on the SRES emission scenarios.	Pfeffer et al. (2008)
Sea level rise (thermosteric)	Global	6 cm by 2045 (5%) 9 cm by 2045 (Median) 14 cm by 2045 (95%)	Very likely;	MIT Integrated Global System Model; Uses the Emissions Prediction and Policy Analysis Model (EPPA), a general equilibrium model of the world economy, for estimating future emissions	Sokolov et al. (2009)
Sea level rise (thermosteric)	Global	16 cm by 2095 (5%) 30 cm by 2095 (Median) 47 cm by 2095 (95%)	Very likely;	MIT Integrated Global System Model; Uses the Emissions Prediction and Policy Analysis Model (EPPA), a general equilibrium model of the world economy, for estimating future emissions	Sokolov et al. (2009)
Sea level rise (thermosteric)	Global	8 cm by 2095 (5%) 19 cm by 2095 (Median) 37 cm by 2095 (95%)	Very likely;	MIT Integrated Global System Model; Uses the Emissions Prediction and Policy Analysis Model (EPPA), a general equilibrium model of the world economy, for estimating future emissions	Webster at al. (2003) as cited in Sokolov et al. (2009)

Global					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Sea level rise	Global	0.9 to 1.3 m for 2090-2099	Not provided	Use 4 parameter linear response equation to relate 2000 years of global tempeature and sea level; estimate likelihood distributions of equation parameters using Monte Carlo inversion; use IPCC AR4 estimates of temperature projections	Grinsted et al. (2009)
Sea level rise	Global	Average rate of sea level rise of 1.6 m by end of the century	Not provided	Usees palaeoclimatic data from the last interglacial period, Marine Isotope Stage (MIS) 5e, when global mean temperatures were at least 2 degrees Celsius warmer than today's temperatures and mean sea level was 4 to 6 meters higher; uses fossil reef data, continuous high-resolution sea-level record based on stable oxygen isotopes of planktonic foraminifera, age constraints from coral data	Rohling et al. (2008)
Sea level rise	Global	"Projections of Greenland ice sheet melt rates for the coming century may be only minimum estimates even without considering positive feedbacks from ice-sheet dynamics"	Not provided	Studies the demise of the Laurentide ice sheet during the early Holocene epoch using terrestrial and marine records of deglaciation, fully coupled AOGCM NASA Goddard Institute for Space Studies ModelE-R	Carlson et al (2008)

National Studies

Climate Variable	U.S. Region	Projection	Certainty	Modeling Parameters	References
		2040-2070			
Temperature increase (mean seasonal)	Eastern United States (corresponds to our definition of Midwest, SE, NE)	+2 to 2.9 degrees C in average surface temperature over June July August by mid-century (2050's)	Not provided; Reasonable agreement across 8 different modeling experiments.	A2 emissions scenario, changes are relative to mean surface temperature across June July August in 1990's ; 8 versions of the MM5, nested within one version of GISS AOGCM to produce range of results produced here	Lynn et al. (2006)
Temperature Increase (mean annual)	Coasts	By the end of the 21st century: Range of 2-3 degrees C in annual surface temperature increases near the coasts in the conterminous United States	Not provided	Scenario not provided. IPCC fourth assessment report climate models. Reference period is 1980-1999.	IPCC (2007) as cited in SAP 4.6 (CCSP, 2008)
Temperature increase (mean seasonal)	Western United States (corresponds to our Pacific Northwest, Great Plains, Southwest)	For 2040 to 2060, 1.5-2 degrees C in summer	Temperature signals were statistically significant at the 0.95 confidence level based on a two-tailed t-test for all seasons and regions	PCM climate model with the MM5; three MM5 ensemble simulations where the initial/boundary conditions are varied; IPCC Business As Usual emission scenario between 1995 and 2100;	Leung et al. (2004)
Temperature increase (mean seasonal)	Western United States (corresponds to our Pacific Northwest, Great Plains, Southwest)	By mid-century (2050s): +2.5 to 3.1 degrees C in average surface temperature over June July August across the western united states, averaging +2.8 degrees C across all models	Not provided; Reasonable agreement across 8 different modeling experiments.	A2 emissions scenario: changes are relative to mean surface temperature across June July August in 1990's. Eight versions of MM5 were used, each nested into one version of GISS AOGCM	Lynn et al. (2006)

National Studies

Climate Variable	U.S. Region	Projection	Certainty	Modeling Parameters	References
Extreme heat events	Continental United States	The recurrence period (or expected average waiting time) for the current 20-year extreme in daily average surface-air temperature reduces to three years over most of the continental United States by the mid-21st century	Not provided	A1B scenario	Kharin, et al. (2007) as cited in SAP 3.3 (CCSP, 2008)
Precipitation (mean seasonal)	Eastern United States (corresponds to our Midwest, Northeast, Southeast)	By mid-century (2050s): -30 to +45 millimeter (mm) change in average precipitation rate over June, July, August	Not provided; range given by 8 different modeling experiments	A2 emissions scenario, changes are relative to average precipitation rates across June July August in 1990's ; range given by 8 versions of MM5, each nested in AOGCM to produce the range of results presented here	Lynn et al. (2006)
Precipitation (in the form of rain, not snow)	Western United States (corresponds to our Pacific Northwest, Great Plains, Southwest)	Projected in 2040-2060, more precipitation in form of rain rather than snow (10-20% reduction in snowfall in the CRB and over 30% reduction in SSJ basin)	Not provided, one model and one emission scenario	PCM climate model with the MM5; three MM5 ensemble simulations where the initial/boundary conditions are varied; IPCC Business As Usual emission scenario between 1995 and 2100;	Leung et al. (2004)
Precipitation (mean seasonal)	Western United States (corresponds to our Pacific Northwest, Great Plains, Southwest)	By mid-century (2050s): -28 to 44 mm change in average precipitation rate over June, July, August	Not provided; range given by 8 different modeling experiments	A2 emissions scenario: Changes are relative to average precipitation rates across June July August in 1990's. Eight versions of MM5 were each embedded in one version of GISS AOGCM to produce the ranges presented here	Lynn et al. (2006)

National Studies					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Extreme precipitation events	North America	By the middle of the 21st century, the recurrence period for the current 20-year extreme in daily total precipitation shortens to between 12 and 15 years over much of North America	Not provided	A1B scenario	Kharin, et al. (2007) as cited in SAP 3.3 (CCSP, 2008)
2070-2100					
Temperature increase (mean annual)	United States	Greater than 2 degees C	Not provided	Nearly all models used in IPCC predict at least a 2 degrees C warming, with 5 out of 21 models projecting average warming in excess of 4 degrees C.	National Sciences and Technology Council (2008)
Temperature (seasonal)	United States	5.4 to 9 degrees Fahrenheit (F) (3 to 5.4 degrees C) for summer temperatures by 2100	Not provided	Preliminary review of adaptation options for climate-sensitive ecosystems and resources	CCSP (2008)
Temperature (seasonal)	United States	12.6 to 18 degrees F (7 to 10.0 degrees C) for winter temperatures by 2100	Not provided	Preliminary review of adaptation options for climate-sensitive ecosystems and resources	CCSP (2008)
Precipitation (mean annual)	United States	Moderate increases in precipitation (10% or less) over much of the United States over the next 100 years, except for the southwest	Not provided	Scenario not known	IPCC (2007) as cited in SAP 4.6 (CCSP, 2008)

Alaska

Climate Variable	U.S. Region	Projection	Certainty	Modeling Parameters	References
2020-2040					
Temperature increase (mean annual)	Alaska	For 2010-2029: Mean increase of 2.9 degrees F (B1) and 3.0 degrees F (A2); likely range is 1.9 to 4.1 degrees F; very likely range is 0.7 to 5.3 degrees F	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Alaska	For 2010-2029: Mean increase of 4.2 degrees F (B1 and A2); likely range is 2.1 to 6.4 degrees F; very likely range is -0.1 to 8.5 degrees F	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (summer: JJA)	Alaska	For 2010-2029: Mean increase of 1.7 degrees F (B1) and 1.8 degrees F (A2); likely range is 0.8 to 2.8 degrees F; very likely range is -0.1 to 3.8 degrees F	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Alaska	For 2010-2029: Mean increase of 2.6 degrees F (B1) and 2.7 degrees F (A2); likely range is 1.3 to 4.2 degrees F; very likely range is -0.2 to 5.6 degrees F	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Alaska					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (fall: SON)	Alaska	For 2010-2029: Mean increase of 3.0 degrees F (B1) and 3.1 degrees F (A2); likely range is 1.8 to 4.3 degrees F; very likely range is 0.5 to 5.6 degrees F	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (mean annual)	Alaska	By 2030: +2 degrees C	Not provided; one emission scenario	A1B scenario relative to 1980-1999; IPCC projections	IPCC (2007) as cited in SAP 4.3 (CCSP, 2008)
Precipitation (winter: DJF)	Alaska	For 2010-2029: Average change of 7.3% (B1) and 8.4% (A2); likely range is 2.5 to 14.4 %; very likely range is -3.5 to 20.3%	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Alaska	For 2010-2029: Average change of 5.5% (B1) and 5.4% (A2); likely range is 0.7 to 10.1% ; very likely range is -4.0 to 14.7%	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Alaska	For 2010-2029: Average change of 6.6% (B1) and 4.7% (A2); likely range is 1.3 to 11.4% ; very likely range is -3.0 to 16.2%	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Alaska					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (fall: SON)	Alaska	For 2010-2029: Average change of 6.4% (B1) and 6.5% (A2); likely range is 1.9 to 10.9% ; very likely range is -2.5 to 15.4%	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Alaska	For 2010-2029: Average change of 6.4% (B1) and 6.1% (A2); likely range is 2.8 to 9.5% ; very likely range is -0.6 to 12.9%	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
2040-2070					
Temperature increase (mean annual)	Alaska	For 2040-2059: Mean increase of 4.8 degrees F (B1) and 5.4 degrees F (A2); likely range is 3.5 to 6.9 degrees F; very likely range is 2.2 to 8.3 degrees F	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Alaska	For 2040-2059: Mean increase of 7.0 degrees F (B1) and 7.8 degrees F (A2); likely range is 4.5 to 10.6 degrees F; very likely range is 2.0 to 13.3 degrees F	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Alaska					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (summer: JJA)	Alaska	For 2040-2059: Mean increase of 2.8 degrees F (B1) and 3.1 degrees F (A2); likely range is 1.6 to 4.5 degrees F; very likely range is 0.1 to 6.0 degrees F	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Alaska	For 2040-2059: Mean increase of 4.3 degrees F (B1) and 5.0 degrees F (A2); likely range is 3.0 to 6.5 degrees F; very likely range is 1.8 to 8.0 degrees F	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (fall: SON)	Alaska	For 2040-2059: Mean increase of 4.8 degrees F (B1) and 5.6 degrees F (A2); likely range is 3.4 to 7.0 degrees F; very likely range is 2.1 to 8.5 degrees F	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (winter: DJF)	Alaska	For 2040-2059: Average change of 12.8% (B1) and 15.6% (A2); likely range is 7.1 to 24.2% ; very likely range is -1.4 to 32.7%	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Alaska					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (summer: JJA)	Alaska	For 2040-2059: Average change of 9.9% (B1) and 11.3% (A2); likely range is 4.2 to 16.8% ; very likely range is -1.5 to 22.3%	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Alaska	For 2040-2059: Average change of 10.2% (B1) and 12.4% (A2); likely range is 5.6 to 19.0% ; very likely range is -0.7 to 25.6%	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (fall: SON)	Alaska	For 2040-2059: Average change of 9.7% (B1) and 12.0% (A2); likely range is 4.9 to 16.4% ; very likely range is 0.0 to 20.9%	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Alaska	For 2040-2059: Average change of 10.6% (B1) and 12.4% (A2); likely range is 6.6 to 17.1% ; very likely range is 2.7 to 21.7%	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Alaska					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
2070-2100					
Temperature increase (mean annual)	Alaska	For 2080-2098: Mean increase of 6.6 degrees F (B1) and 10.4 degrees F (A2); likely range is 5.0 to 13.1 degrees F; very likely range is 3.4 to 15.7 degrees F	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Alaska	For 2080-2098: Mean increase of 9.7 degrees F (B1) and 15.0 degrees F (A2); likely range is 7.3 to 19.8 degrees F; very likely range is 4.8 to 24.5 degrees F	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (summer: JJA)	Alaska	For 2080-2098: Mean increase of 4.0 degrees F (B1) and 6.5 degrees F (A2); likely range is 2.2 to 8.9 degrees F; very likely range is 0.4 to 11.4 degrees F	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Alaska	For 2080-2098: Mean increase of 6.0 degrees F (B1) and 9.7 degrees F (A2); likely range is 4.1 to 12.4 degrees F; very likely range is 2.1 to 15.2 degrees F	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Alaska					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (fall: SON)	Alaska	For 2080-2098: Mean increase of 6.4 degrees F (B1) and 10.3 degrees F (A2); likely range is 4.9 to 12.5 degrees F; very likely range is 3.4 to 14.6 degrees F	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (mean annual)	Northern Alaska	More than 5 degrees C in annual surface temperature increases by the end of the 21st century	Not provided	Without discussion of respective scenario; also cited in EPA 2009; provided by IPCC projections	IPCC (2007) as cited in SAP 4.6 (CCSP, 2008)
Temperature anomalies (hot days)	Alaska	For 2080-2100: 1-in-20-year extreme heat event currently is projected to occur every 10 years	Not provided; one emission scenario	A2 scenario; change in frequency of 1-in-20-year extreme heat events is relative to today;	CMIP3-A (2008) as cited in USGCRP 2009
Temperature increase (permafrost thawing)	Seward Peninsula, Northern Alaska	By late century (2090-2100): 0 to +3.2 degrees C increase in permafrost temperatures by late century Largest change is on the coasts; some high elevation area become slightly colder.	Not provided; one emission scenario	A1B scenario; temperature change is given relative to present temperatures (2001-2004), uses the TOPP numerical model	R.C. Busey et al. (2008)
Precipitation (winter: DJF)	Alaska	For 2080-2098: Average change of 19.4% (B1) and 32.6% (A2); likely range is 12.5 to 47.6% ; very likely range is 2.6 to 62.6%	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Alaska					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (summer: JJA)	Alaska	For 2080-2098: Average change of 14.3% (B1) and 21.7% (A2); likely range is 9.3 to 30.2% ; very likely range is 4.3 to 38.7%	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Alaska	For 2080-2098: Average change of 16.5% (B1) and 27.9% (A2); likely range is 11.2 to 39.2% ; very likely range is 5.4 to 50.4%	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (fall: SON)	Alaska	For 2080-2098: Average change of 13.8% (B1) and 25.4% (A2); likely range is 8.3 to 34.2% ; very likely range is 2.7 to 42.9%	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Alaska	For 2080-2098: Average change of 15.6% (B1) and 26.0% (A2); likely range is 11.6 to 34.1% ; very likely range is 7.6 to 42.3%	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
			2020-2040		
Temperature increase (mean annual)	Northeast (USGCRP region)	Mean increase of 2.5 degrees F (B1) and 2.5 degrees F (A2); likely range is 1.9 to 3.2 degrees F for 2010-2029; very likely range is 1.3 to 3.8 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Northeast (USGCRP region)	Mean increase of 3.0 degrees F (B1) and 2.8 degrees F (A2); likely range is 1.8 to 3.8 degrees F for 2010-2029; very likely range is 0.9 to 4.7 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (summer: JJA)	Northeast (USGCRP region)	Mean increase of 2.3 degrees F (B1) and 2.5 degrees F (A2); likely range is 1.8 to 3.1 degrees F for 2010-2029; very likely range is 1.3 to 3.7 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Northeast (USGCRP region)	Mean increase of 2.2 degrees F (B1) and 2.0 degrees F (A2); likely range is 1.2 to 3.0 degrees F for 2010-2029; very likely range is 0.4 to 3.8 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (fall: SON)	Northeast (USGCRP region)	Mean increase of 2.5 degrees F (B1) and 2.7 degrees F (A2); likely range is 1.9 to 3.3 degrees F for 2010-2029; very likely range is 1.2 to 3.9 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature (mean annual and seasonal)	Northeast (ME, NH, VT, MA, RI, CT, NY, NJ, PA)	For 2010-2039, Increase in annual mean temperature: 2.4 degrees F (Low emissions); 2.6 degrees F (High emissions). Increase in winter (DJF) temperature: mean range of 3.3 to 3.4 degrees F with a range of 2.5 to 4 degrees F. Increase in summer (JJA) temperature: mean range of 2.2 to 2.6 with a range of 1.5 to 3.5 degrees F.	Not provided; uses three climate models to capture climate sensitivity bracketed by two emission scenarios	B1 emission scenario (lower emissions scenario), A1Fi emission scenario (higher emission scenario); Reference years of 1961-1990; Using three models: GFDL CM2.1, Hadley Centre Climate Model v3, and NCAR Parallel Climate Model (PCM) and using statistical downscaling	NECIA (2006); Frumhoff et al. 2007
Temperature (mean annual and seasonal)	Pennsylvania	Over the next several decades (2010–2039), annual average temperatures across Pennsylvania are projected to increase by 2.5 degrees F, under either emissions scenario; That average includes a slightly greater increase in winter temperatures (just under 3 degrees F) than in summer temperatures (around 2.5 degrees F), with smaller changes expected in spring and fall	Not provided; uses three climate models to capture climate sensitivity bracketed by two emission scenarios	B1 emission scenario (lower emissions scenario), A1Fi emission scenario (higher emission scenario); Reference years of 1961-1990; Using three models: GFDL CM2.1, Hadley Centre Climate Model v3, and NCAR Parallel Climate Model (PCM) and using statistical downscaling	UCS (2008)

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Extreme heat event	Boston	increase of 4 (B1) to 8 (A1Fi) days per year above 90 degrees F in 2010-2039 compared to 1961-1990	Not provided; uses three climate models to capture climate sensitivity bracketed by two emission scenarios	Higher emission scenario is A1Fi and lower emission scenario is B1; MM5-based regional modeling, statistical downscaling, uses CM2.1, HadCM3, and PCM climate models	Hayhoe et al (2008) in USGCRP (2009)
Extreme heat event (days per year over 90 degrees F)	Northeast cities	Approximate number of days of extreme heat greater than 90 degrees F for the following cities (mean values for low to high emission) for 2010-2039 (values for reference period, 1960-1990, provided in parenthesis): Buffalo: 6 to 9 days (~4 days) Boston: 15 to 18 days (~9 days) Concord/Manchester: 16 to 19 days (~10 days) Hartford: 22 to 25 days (~15 days) New York City: 21 to 22 days (~16 days) Philadelphia: 28 to 30 days (~19 days) Pittsburgh: 19 to 20 days (~9 days)	Not provided; uses three climate models to capture climate sensitivity bracketed by two emission scenarios	B1 emission scenario (lower emissions scenario), A1Fi emission scenario (higher emission scenario); Using three models: GFDL CM2.1, Hadley Centre Climate Model v3, and NCAR Parallel Climate Model (PCM) and statistical downscaling; number of days > 100 degrees also available	NECIA (2006); information provided by Figure 5

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Extreme heat event	Pennsylvania	In the next several decades, much of the state can expect substantially more days over 90 degrees F—in most cases, at least a doubling	Not provided; uses three climate models to capture climate sensitivity bracketed by two emission scenarios	B1 emission scenario (lower emissions scenario), A1Fi emission scenario (higher emission scenario); Reference years of 1961-1990; Using three models: GFDL CM2.1, Hadley Centre Climate Model v3, and NCAR Parallel Climate Model (PCM) and using statistical downscaling	UCS (2008)
Precipitation (winter: DJF)	Northeast (USGCRP region)	Average change of 6.3% (B1) and 6.3% (A2); likely range is 2.0 to 10.7 % for 2010-2029; very likely range is -2.4 to 15.1% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Northeast (USGCRP region)	Average change of 2.3% (B1) and 2.3% (A2); likely range is -1.2 to 5.9 % for 2010-2029; very likely range is -4.8 to 9.5% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Northeast (USGCRP region)	Average change of 2.9% (B1) and 2.6% (A2); likely range is -2.0 to 7.3 % for 2010-2029; very likely range is -6.6 to 11.9% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (fall: SON)	Northeast (USGCRP region)	Average change of 1.6% (B1) and 0.6% (A2); likely range is -4.4 to 6.1 % for 2010-2029; very likely range is -9.5 to 10.6% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Northeast (USGCRP region)	Average change of 3.2% (B1) and 2.9% (A2); likely range is 0.5 to 5.8 % for 2010-2029; very likely range is -2.0 to 8.4% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (intensity, duration)	Northeast (ME, NH, VT, MA, RI, CT, NY, NJ, PA)	Precipitation intensity to increase by more than 7% (low scenario) to 7% (high scenario) Number of days with rain greater than 2 in to increase 1 day (low scenario) to 1.25 day (high scenario) Maximum amount of precipitation to fall during a five-day period each year to increase by 9% (low scenario) to 12% (high scenario)	Not provided; uses two climate models bracketed by two emission scenarios	B1 emission scenario (lower emissions scenario), A1Fi emission scenario (higher emission scenario); Reference years of 1961-1990; Using two models: GFDL CM2.1, and NCAR Parallel Climate Model (PCM) and using statistical downscaling	NECIA (2006); information provided by Figure 7
2040-2070					
Temperature increase (mean annual)	Northeast (USGCRP region)	Mean increase of 3.8 degrees F (B1) and 4.8 degrees F (A2); likely range is 2.8 to 5.8 degrees F for 2040-2059; very likely range is 1.9 to 6.8 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (winter: DJF)	Northeast (USGCRP region)	Mean increase of 4.0 degrees F (B1) and 5.4 degrees F (A2); likely range is 2.9 to 6.6 degrees F for 2040-2059; very likely range is 1.8 to 7.9 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (summer: JJA)	Northeast (USGCRP region)	Mean increase of 3.7 degrees F (B1) and 4.8 degrees F (A2); likely range is 2.8 to 5.8 degrees F for 2040-2059; very likely range is 1.8 to 6.9 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Northeast (USGCRP region)	Mean increase of 3.5 degrees F (B1) and 4.1 degrees F (A2); likely range is 2.2 to 5.5 degrees F for 2040-2059; very likely range is 0.9 to 6.8 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (fall: SON)	Northeast (USGCRP region)	Mean increase of 3.9 degrees F (B1) and 4.8 degrees F (A2); likely range is 2.8 to 5.6 degrees F for 2040-2059; very likely range is 1.8 to 6.5 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature (mean annual and seasonal)	Northeast (ME, NH, VT, MA, RI, CT, NY, NJ, PA)	For 2040-2069; Increase in annual mean temperature: 3.7 degrees F (Low emissions) and 5.8 degrees F (High emissions). Increase in winter (DJF) temperature: mean of 4.3 to 6.1 and a range of 4 to 7 degrees F. Increase in summer (JJA) temperature: mean of 3.8 to 6.4 and a range of 2 to 8 degrees F.	Not provided; uses three climate models to capture climate sensitivity bracketed by two emission scenarios, the range provided in the report describes impacts as "likely", suggesting at least a 66% certainty, if not higher.	B1 emission scenario (lower emissions scenario), A1Fi emission scenario (higher emission scenario); Reference years of 1961-1990; Using three models: GFDL CM2.1, Hadley Centre Climate Model v3, and NCAR Parallel Climate Model (PCM) and using statistical downscaling	NECIA (2006), Frumhoff et al. (2007)
Temperature (mean annual)	Pennsylvania	By mid-century (2040–2069), differences between the emissions pathways begin to appear; Under the lower-emissions scenario, annual temperatures in Pennsylvania warm by slightly less than 4 degrees F, while under the higher-emissions scenario they warm by more than 5.5 degrees F	Not provided; uses three climate models to capture climate sensitivity bracketed by two emission scenarios	B1 emission scenario (lower emissions scenario), A1Fi emission scenario (higher emission scenario); Reference years of 1961-1990; Using three models: GFDL CM2.1, Hadley Centre Climate Model v3, and NCAR Parallel Climate Model (PCM) and using statistical downscaling	UCS (2008)

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Extreme heat event	Northeast cities	Approximate number of days of extreme heat > 90 degrees F for the following cities (mean values are for low to high emission) (2040 to 2069) (values for reference period, 1960-1990, provided in parenthesis): Buffalo: 12 to 28 days (~4 days) Boston: 25 to 39 days (~9 days) Concord/Manchester: 25 to 39 days (~10 days) Hartford: 37 to 50 days (~15 days) New York City: 34 to 50 days (~16 days) Philadelphia: 40 to 58 days (~19 days) Pittsburgh: 25 to 42 days (~9 days)	Not provided; uses three climate models to capture climate sensitivity bracketed by two emission scenarios	B1 emission scenario (lower emissions scenario), A1Fi emission scenario (higher emission scenario); Using three models: GFDL CM2.1, Hadley Centre Climate Model v3, and NCAR Parallel Climate Model (PCM) and using statistical downscaling; number of days > 100 degrees also available; Reference period is 1960-1990	NECIA (2006); information provided by Figure 5
Extreme heat event	Pennsylvania	By mid-century, parts of southwestern and southeastern Pennsylvania could experience more than 50 days a year over 90 degrees F	Not provided; uses three climate models to capture climate sensitivity with one emission scenario	A1Fi emission scenario; Reference years of 1961-1990; Using three models: GFDL CM2.1, Hadley Centre Climate Model v3, and NCAR Parallel Climate Model (PCM) and using statistical downscaling	UCS (2008)
Extreme heat event	Boston	Increase of 12 (low scenario) to 29 (high scenario) days per year above 90 degrees F in 2040-2069 compared to 1961-1990	Not provided; uses three climate models bracketed by two emission scenarios	Higher emission scenario is A1Fi and lower emission scenario is B1; MM5-based regional modeling, statistical downscaling, uses CM2.1, HadCM3, and PCM climate models	Hayhoe et al (2008) in USGCRP (2009)

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (winter: DJF)	Northeast (USGCRP region)	Average change of 7.9% (B1) and 11.0% (A2); likely range is 2.2 to 18.4 % for 2040-2059; very likely range is -3.9 to 25.8% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Northeast (USGCRP region)	Average change of 2.3% (B1) and 0.9% (A2); likely range is -5.6 to 7.4 % for 2040-2059; very likely range is -12.1 to 13.9% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Northeast (USGCRP region)	Average change of 5.4% (B1) and 5.9% (A2); likely range is 0.3 to 11.6 % for 2040-2059; very likely range is -5.4 to 17.3% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (fall: SON)	Northeast (USGCRP region)	Average change of 2.8% (B1) and 3.1% (A2); likely range is -3.1 to 9.3 % for 2040-2059; very likely range is -9.2 to 15.5% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (mean annual)	Northeast (USGCRP region)	Average change of 4.5% (B1) and 5.1% (A2); likely range is 0.8 to 9.4 % for 2040-2059; very likely range is -3.5 to 13.7% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (seasonal)	Northeast (ME, NH, VT, MA, RI, CT, NY, NJ, PA)	By mid-century, winter precipitation could increase between 11 (lower emissions) and 16% (higher emissions) on average	Not provided; uses three climate models to capture climate sensitivity bracketed by two emission scenarios	B1 emission scenario (lower emissions scenario), A1Fi emission scenario (higher emission scenario); Reference years of 1961-1990; Using three models: GFDL CM2.1, Hadley Centre Climate Model v3, and NCAR Parallel Climate Model (PCM) and using statistical downscaling	NECIA (2006)
Precipitation (intensity, duration)	Northeast (ME, NH, VT, MA, RI, CT, NY, NJ, PA)	Precipitation intensity to increase by more than 8% (low/high scenario) Number of days with rain greater than 2 in to increase 1 day (low scenario) to 1.5 day (high scenario) Maximum amount of precipitation to fall during a five-day period each year to increase by 8% (low scenario) to 13% (high scenario)	Not provided; uses two climate models bracketed by two emission scenarios	B1 emission scenario (lower emissions scenario), A1Fi emission scenario (higher emission scenario); Reference years of 1961-1990; Using two models: GFDL CM2.1, and NCAR Parallel Climate Model (PCM) and using statistical downscaling	NECIA (2006); information provided by Figure 7

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (mean annual)	Pennsylvania	Over the next several decades and through mid-century, precipitation is expected to increase statewide by more than 5% above the historical average	Not provided; uses three climate models to capture climate sensitivity bracketed by two emission scenarios	B1 emission scenario (lower emissions scenario), A1Fi emission scenario (higher emission scenario); Reference years of 1961-1990; Using three models: GFDL CM2.1, Hadley Centre Climate Model v3, and NCAR Parallel Climate Model (PCM) and using statistical downscaling	UCS (2008)
Precipitation, storm events	Northeast (NY, CT, ME, NH, VT, RI, NY, NJ)	By mid-century (2040-2060): 1) 8% to 9% increase in precipitation intensity (average amount of precipitation that falls on any rainy day); 2) 8% increase in heavy precipitation events (more than two in of rain falling in 48 hours); and 3) 10% more rainfall during the wettest five-day periods of each year	Not provided; uses two climate models with one emission scenario	A1Fi emission scenario; Reference years of 1961-1990; Using two models: GFDL CM2.1, and NCAR Parallel Climate Model (PCM) and using statistical downscaling	Frumhoff et al. (2007) based on NECIA (2006) data

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Storm surge	Atlantic City, NJ	For 2050, a 2005 100-year flood is projected to be a: (1) 5 year event (extrapolating from obs), (2) 4 year event (B1), (3) 4 year event (A1Fi), and (4) less than 2 year event (Rahmstorf) The MHHW 100-year storm surge elevation (NAVD) is expected to increase by approximately: (1) 518 mm (extrapolating from obs), (2) 550 mm (B1), (3) 580 mm (A1Fi), and (4) 732 mm (Rahmstorf)	Not provided; draws from varying SLR projections available in the literature	Compared to 2005 levels; uses four sea level rise projections: extrapolation of historical trend 1961 to 2003 of 0.18mm/year, lower emission IPCC AR4 scenario, high emission IPCC AR4 scenario, and a high emission scenario based on Rahmstorf (2007). This study accounts for observed storm surge anomalies and changes in land elevation (local subsidence/uplift). Oceanic storm responses from tide gauges are measured only during coastal flooding events.	Kirshen et al (2008)
Storm surge	New York City, NY	For 2050, a 2005 100-year flood is projected to be a: (1) 60 year event (extrapolating from obs), (2) 50 year event (B1), (3) 46 year event (A1Fi), and (4) 24 year event (Rahmstorf) The MHHW 100-year storm surge elevation (NAVD) is expected to increase by approximately: (1) 122 mm (extrapolating from obs), (2) 152 mm (B1), (3) 183 mm (A1Fi), and (4) 335 mm (Rahmstorf)	Not provided; draws from varying SLR projections available in the literature	Compared to 2005 levels, predicts eustatic SLR; uses four sea level rise projections: extrapolation of historical trend 1961 to 2003 of 0.18mm/year, lower emission IPCC AR4 scenario, high emission IPCC AR4 scenario, and a high emission scenario based on Rahmstorf (2007). This study accounts for observed storm surge anomalies and changes in land elevation (local subsidence/uplift). Tide gauges due to their location measure both storm surge and increased river flow during coastal flooding event.	Kirshen et al (2008)

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Storm surge	Boston, MA	For 2050, a 2005 100-year flood is projected to be a: (1) 3 year event (extrapolating from obs), (2) 3 year event (B1), (3) 2 year event (A1Fi), and (4) less than a 2 year event (Rahmstorf) The MHHW 100-year storm surge elevation (NAVD) is expected to increase by approximately: (1) 244 mm (extrapolating from obs), (2) 305 mm (B1), (3) 305 mm (A1Fi), and (4) 457 mm (Rahmstorf)	Not provided; draws from varying SLR projections available in the literature	Compared to 2005 levels, predicts eustatic SLR; uses four sea level rise projections: extrapolation of historical trend 1961 to 2003 of 0.18mm/year, lower emission IPCC AR4 scenario, high emission IPCC AR4 scenario, and a high emission scenario based on Rahmstorf (2007). This study accounts for observed storm surge anomalies and changes in land elevation (local subsidence/uplift). Oceanic storm responses from tide gauges are measured in Boston only during coastal flooding events.	Kirshen et al (2008)
Storm surge	New London, CT	For 2050, a 2005 100-year flood is projected to be a: (1) 72 year event (extrapolating from obs), (2) 61 year event (B1), (3) 56 year event (A1Fi), and (4) 31 year event (Rahmstorf) The MHHW 100-year storm surge elevation (NAVD) is expected to increase by approximately: (1) 61 mm (extrapolating from obs), (2) 122 mm (B1), (3) 122 mm (A1Fi), and (4) 274 mm (Rahmstorf)	Not provided; draws from varying SLR projections available in the literature	Compared to 2005 levels, predicts eustatic SLR; uses four sea level rise projections: extrapolation of historical trend 1961 to 2003 of 0.18mm/year, lower emission IPCC AR4 scenario, high emission IPCC AR4 scenario, and a high emission scenario based on Rahmstorf (2007). This study accounts for observed storm surge anomalies and changes in land elevation (local subsidence/uplift). Tide gauges due to their location measure both storm surge and increased river flow during coastal flooding event.	Kirshen et al (2008)

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Storm surge	Woods Hole, MA	For 2050, a 2005 100-year flood is projected to be a: (1) 61 year event (extrapolating from obs), (2) 51 year event (B1), (3) 46 year event (A1Fi), and (4) 22 year event (Rahmstorf) The MHHW 100-year storm surge elevation (NAVD) is expected to increase by approximately: (1) 91 mm (extrapolating from obs), (2) 152 mm (B1), (3) 152 mm (A1Fi), and (4) 305 mm (Rahmstorf)	Not provided; draws from varying SLR projections available in the literature	Compared to 2005 levels, predicts eustatic SLR; uses four sea level rise projections: extrapolation of historical trend 1961 to 2003 of 0.18mm/year, lower emission IPCC AR4 scenario, high emission IPCC AR4 scenario, and a high emission scenario based on Rahmstorf (2007). This study accounts for observed storm surge anomalies and changes in land elevation (local subsidence/uplift). Tide gauges due to their location measure both storm surge and increased river flow during coastal flooding event.	Kirshen et al (2008)
2070-2100					
Temperature increase (mean annual)	Northeast (USGCRP region)	Mean increase of 5.4 degrees F (B1) and 9.0 degrees F (A2); likely range is 4.2 to 10.8 degrees F for 2080-2098; very likely range is 3.0 to 12.5 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Northeast (USGCRP region)	Mean increase of 5.9 degrees F (B1) and 9.3 degrees F (A2); likely range is 4.7 to 11.0 degrees F for 2080-2098; very likely range is 3.5 to 12.8 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (summer: JJA)	Northeast (USGCRP region)	Mean increase of 5.2 degrees F (B1) and 9.4 degrees F (A2); likely range is 3.9 to 11.8 degrees F for 2080-2098; very likely range is 2.7 to 14.1 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Northeast (USGCRP region)	Mean increase of 5.0 degrees F (B1) and 8.1 degrees F (A2); likely range is 3.6 to 10.0 degrees F for 2080-2098; very likely range is 2.3 to 11.9 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (fall: SON)	Northeast (USGCRP region)	Mean increase of 5.3 degrees F (B1) and 9.1 degrees F (A2); likely range is 3.9 to 10.8 degrees F for 2080-2098; very likely range is 2.5 to 12.5 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature (mean annual and seasonal)	Northeast (ME, NH, VT, MA, RI, CT, NY, NJ, PA)	By 2070-2099, Increase in annual temperature: 5.0 degrees F (Low emissions) and 9.5 degrees F (High emissions). Increase in winter (DJF) temperature: mean of 5.8 to 9.8 degrees F and range of 6 to 12 degrees F. Increase in summer (JJA) temperature: mean of 5.1 to 10.6 and a range of 3 to 14 degrees F by 2070–2099	Not provided; uses three climate models to capture climate sensitivity bracketed by two emission scenarios	B1 emission scenario (lower emissions scenario), A1Fi emission scenario (higher emission scenario); Reference years of 1961-1990; Using two models: GFDL CM2.1, Hadley Centre Climate Model v3, and NCAR Parallel Climate Model (PCM) and using statistical downscaling	NECIA (2006); Frumhoff (2007)

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (mean annual)	Coasts	Range of 2-3 degrees C in annual surface temperature increases near the coasts in the conterminous United States by the end of the 21st century	Not provided	IPCC estimates	IPCC (2007) as cited in SAP 4.6 (CCSP, 2008)
Temperature increase (mean annual)	Pennsylvania	By late this century (2070–2099), average winter temperatures are projected to rise 8 degrees F above historic levels, and summer temperatures to rise 11degrees F, if heat-trapping emissions remain high; under a lower-emissions future, the warming is projected to be about half as much	Not provided; uses three climate models to capture climate sensitivity bracketed by two emission scenarios	B1 emission scenario (lower emissions scenario), A1Fi emission scenario (higher emission scenario); Reference years of 1961-1990; Using three models: GFDL CM2.1, Hadley Centre Climate Model v3, and NCAR Parallel Climate Model (PCM) and using statistical downscaling	UCS (2008)
Extreme heat event	Northeast cities	Currently, northeastern cities experience one or two days per summer over 100 degrees F; This number could increase by late century to between three and nine days under lower emissions and between 14 and 28 days under higher emissions	Not provided; uses three climate models to capture climate sensitivity bracketed by two emission scenarios	B1 emission scenario (lower emissions scenario), A1Fi emission scenario (higher emission scenario); Reference to 1961 to 1990; Using three models: GFDL CM2.1, Hadley Centre Climate Model v3, and NCAR Parallel Climate Model (PCM) and using statistical downscaling;	NECIA (2006)

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Extreme heat event	Northeast cities	Approximate number of days of extreme heat above 90 degrees F for the following cities (mean values are for low to high emission) (2070 to 2099) (values for reference period, 1960-1990, provided in parenthesis): Buffalo: 17 to 48 days (~ 4 days) Boston: 31 to 64 days (~ 9 days) Concord/Manchester: 32 to 65 days (~10 days) Hartford: 42 to 78 days (~ 15 days) New York City: 39 to 71 days (~16 days) Philadelphia: 45 to 80 days (~19 days) Pittsburgh: 30 to 64 days (~ 9 days)	Not provided; uses three climate models to capture climate sensitivity bracketed by two emission scenarios	B1 emission scenario (lower emissions scenario), A1Fi emission scenario (higher emission scenario); Using three models: GFDL CM2.1, Hadley Centre Climate Model v3, and NCAR Parallel Climate Model (PCM) and using statistical downscaling; number of days > 100 degrees also available	NECIA (2006); information provided by Figure 5
Extreme heat event	Northeast (USGCRP region)	1-in-20-year extreme heat event (combination of high temperature and humidity) is projected to occur every 2 years by late-century (2080-2100)	Not provided; multiple number of climate models, for one emission scenario	A2 scenario; change in frequency of 1-in-20-year extreme heat events is relative to today;	CMIP3-A (2008) as cited in USGCRP 2009

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Extreme heat event	Pennsylvania	By late century, much of the southern half the state is projected to endure more than 70 days a year with temperatures higher than 90 degrees F	Not provided; uses three climate models to capture climate sensitivity bracketed by two emission scenarios	B1 emission scenario (lower emissions scenario), A1Fi emission scenario (higher emission scenario); Reference years of 1961-1990; Using three models: GFDL CM2.1, Hadley Centre Climate Model v3, and NCAR Parallel Climate Model (PCM) and using statistical downscaling	UCS (2008)
Extreme heat event	Boston	For 2070-2099: increase of 20 (low emission scenario) to 52 (high emission scenario) days per year above 90 degrees F	Not provided; uses three climate models to capture climate sensitivity bracketed by two emission scenarios	Higher emission scenario is A1Fi and lower emission scenario is B1; Reference year is 1961-1990; MM5-based regional modeling, statistical downscaling, uses CM2.1, HadCM3, and PCM climate models	Hayhoe et al (2008) in USGCRP (2009)
Precipitation (winter: DJF)	Northeast (USGCRP region)	Average change of 11.2% (B1) and 17.2% (A2); likely range is 3.6 to 26.7 % for 2080-2098; very likely range is -3.9 to 36.2% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Northeast (USGCRP region)	Average change of 2.0% (B1) and -0.6% (A2); likely range is -12.2 to 10.9 % for 2080-2098; very likely range is -23.8 to 22.5% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (spring: MAM)	Northeast (USGCRP region)	Average change of 8.8% (B1) and 10.8% (A2); likely range is 0.7 to 20.9 % for 2080-2098; very likely range is -9.4 to 31.0% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (fall: SON)	Northeast (USGCRP region)	Average change of 2.9% (B1) and 4.0% (A2); likely range is -5.3 to 13.2 % for 2080-2098; very likely range is -14.6 to 22.5% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Northeast (USGCRP region)	Average change of 6.1% (B1) and 7.5% (A2); likely range is 0.5 to 14.6 % for 2080-2098; very likely range is -6.6 to 21.7% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual and seasonal)	Northeast (NY, CT, ME, NH, VT, RI, NY, NJ)	2080-2099: 10% total increase by late-century; Winter precipitation could increase by 20 to 30% by late-century; little change in summer rainfall projected.	Not provided; uses three climate models to capture climate sensitivity with one emission scenario	A1FI scenario, report does not state what time-frame the projected change in precipitation is relative to but does provide information that a 10% increase is roughly 4 in per year of precipitation; Reference years of 1961-1990; Using three models: GFDL CM2.1, Hadley Centre Climate Model v3, and NCAR Parallel Climate Model (PCM) and using statistical downscaling	NECIA (2006); Frumhoff et al. (2007)

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (intensity, duration)	Northeast (ME, NH, VT, MA, RI, CT, NY, NJ, PA)	Precipitation intensity to increase by more than 12% (low scenario) to 13% (high scenario) Number of days with rain greater than 2 in to increase 1.25 day (low scenario) to 1.75 day (high scenario) Maximum amount of precipitation to fall during a five-day period each year to increase by 18% (low scenario) to 22% (high scenario)	Not provided; uses two climate models bracketed by two emission scenarios	B1 emission scenario (lower emissions scenario), A1Fi emission scenario (higher emission scenario); Reference years of 1961-1990; Using two models: GFDL CM2.1, and NCAR Parallel Climate Model (PCM) and using statistical downscaling	NECIA (2006); information provided by Figure 7
Precipitation (snowpack)	Northeast (ME, NH, VT, MA, RI, CT, NY, NJ, PA)	By the end of the century, most of the Northeast could lose four to eight snow-covered days per month under the lower-emissions scenario and 10 to 15 snow-covered days per month under the higher-emissions scenario; Large reduction in the length of the snow season in winter/early spring of more than 25% (low emission) to 50% (high emission)	Not provided; uses three climate models to capture climate sensitivity bracketed by two emission scenarios	B1 emission scenario (lower emissions scenario), A1Fi emission scenario (higher emission scenario); Reference to 1961 to 1990; Using three models: GFDL CM2.1, Hadley Centre Climate Model v3, and NCAR Parallel Climate Model (PCM) and using statistical downscaling;	NECIA (2006)
Precipitation (winter snow)	Northeast (NY, NJ, NH, ME, VT, MA, CT, RI)	For 2070-2090: Up to a 50% reduction in snow season length in northern parts of Northeast	Not provided; two climate models, two emission scenarios	Modeled two emissions scenarios: A1FI (higher emissions) and B1 (lower emissions), changes are relative to 1961-1990 period; using HadCM3 and PCM models and the VIC land surface model	Sheffield, Luo, Troy, Wood (2006)

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (mean annual)	Pennsylvania	Over the next several decades and through mid-century, precipitation is expected to increase statewide by more than 12% under either scenario	Not provided; uses three climate models to capture climate sensitivity bracketed by two emission scenarios	B1 emission scenario (lower emissions scenario), A1Fi emission scenario (higher emission scenario); Reference years of 1961-1990; Using three models: GFDL CM2.1, Hadley Centre Climate Model v3, and NCAR Parallel Climate Model (PCM) and using statistical downscaling	UCS (2008)
Storm events	Northeast (ME, NH, VT, MA, RI, CT, NY, NJ, PA)	Under the higher-emissions scenario, between 5 and 15% more of the storms that occur during late winter (January, February, and March) will move far enough northward by century's end to affect the Northeast; Hence, there is some indication that global warming may increase the number of late winter storms experienced in the Northeast by about one additional storm per year under the higher-emissions scenario	Not provided; uses two climate models bracketed by two emission scenarios	B1 emission scenario (lower emissions scenario), A1Fi emission scenario (higher emission scenario); Using two models: GFDL CM2.1 and NCAR Parallel Climate Model (PCM) and statistical downscaling;	NECIA (2006)

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Storm surge	Atlantic City, NJ	For 2050, a 2005 100-year flood is projected to be occur less than every 2 years for all scenarios. The MHHW 100-year storm surge elevation (NAVD) is expected to increase by approximately: (1) 1,070 mm (extrapolating from obs), (2) 1,190 mm (B1), (3) 1,341 mm (A1Fi), and (4) 1890 mm (Rahmstorf)	Not provided; draws from varying SLR projections available in the literature	Compared to 2005 levels, predicts eustatic SLR; uses four sea level rise projections: extrapolation of historical trend 1961 to 2003 of 0.18mm/year, lower emission IPCC AR4 scenario, high emission IPCC AR4 scenario, and a high emission scenario based on Rahmstorf (2007). This study accounts for observed storm surge anomalies and changes in land elevation (local subsidence/uplift). Oceanic storm responses from tide gauges are measured only during coastal flooding events.	Kirshen et al (2008)
Storm surge	New York City, NY	For 2100, a 2005 100-year flood is projected to be a: (1) 34 year event (extrapolating from obs), (2) 22 year event (B1), (3) 11 year event (A1Fi), and (4) less than 2 year event (Rahmstorf) The MHHW 100-year storm surge elevation (NAVD) is expected to increase by approximately: (1) 234 mm (extrapolating from obs), (2) 366 mm (B1), (3) 518 mm (A1Fi), and (4) 1,070 mm (Rahmstorf)	Not provided; draws from varying SLR projections available in the literature	Compared to 2005 levels, predicts eustatic SLR; uses four sea level rise projections: extrapolation of historical trend 1961 to 2003 of 0.18mm/year, lower emission IPCC AR4 scenario, high emission IPCC AR4 scenario, and a high emission scenario based on Rahmstorf (2007). This study accounts for observed storm surge anomalies and changes in land elevation (local subsidence/uplift). Tide gauges due to their location measure both storm surge and increased river flow during coastal flooding event.	Kirshen et al (2008)

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Storm surge	Boston, MA	For 2100, a 2005 100-year flood is projected to be a less than every 2 years for all scenarios. The MHHW 100-year storm surge elevation (NAVD) is expected to increase by approximately: (1) 550 mm (extrapolating from obs), (2) 640 mm (B1), (3) 792 mm (A1Fi), and (3) 1,340 mm (Rahmstorf)	Not provided; draws from varying SLR projections available in the literature	Compared to 2005 levels; uses four sea level rise projections: extrapolation of historical trend 1961 to 2003 of 0.18mm/year, lower emission IPCC AR4 scenario, high emission IPCC AR4 scenario, and a high emission scenario based on Rahmstorf (2007). This study accounts for observed storm surge anomalies and changes in land elevation (local subsidence/uplift). Oceanic storm responses from tide gauges are measured in Boston only during coastal flooding events.	Kirshen et al (2008)
Storm surge	New London, CT	For 2100, a 2005 100-year flood is projected to be a: (1) 49 year event (extrapolating from obs), (2) 32 year event (B1), (3) 17 year event (A1Fi), and (4) 2 year event (Rahmstorf) The MHHW 100-year storm surge elevation (NAVD) is expected to increase by approximately: (1) 183 mm (extrapolating from obs), (2) 274 mm (B1), (3) 458 mm (A1Fi), and (4) 975 mm (Rahmstorf)	Not provided; draws from varying SLR projections available in the literature	Compared to 2005 levels, predicts eustatic SLR; uses four sea level rise projections: extrapolation of historical trend 1961 to 2003 of 0.18mm/year, lower emission IPCC AR4 scenario, high emission IPCC AR4 scenario, and a high emission scenario based on Rahmstorf (2007). This study accounts for observed storm surge anomalies and changes in land elevation (local subsidence/uplift). Tide gauges due to their location measure both storm surge and increased river flow during coastal flooding event.	Kirshen et al (2008)

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Storm surge	Woods Hole, MA	For 2100, a 2005 100-year flood is projected to be a: (1) 34 year event (extrapolating from obs), (2) 21 year event (B1), (3) 9 year event (A1Fi), and (4) les than a 2 year event (Rahmstorf) The MHHW 100-year storm surge elevation (NAVD) is expected to increase by approximately: (1) 213 mm (extrapolating from obs), (2) 335 mm (B1), (3) 490 mm (A1Fi), and (4) 732 mm (Rahmstorf)	Not provided; draws from varying SLR projections available in the literature	Compared to 2005 levels, predicts eustatic SLR; uses four sea level rise projections: extrapolation of historical trend 1961 to 2003 of 0.18mm/year, lower emission IPCC AR4 scenario, high emission IPCC AR4 scenario, and a high emission scenario based on Rahmstorf (2007). This study accounts for observed storm surge anomalies and changes in land elevation (local subsidence/uplift). Tide gauges due to their location measure both storm surge and increased river flow during coastal flooding event.	Kirshen et al (2008)
Sea level rise (total)	New York City	For 2091-2100: 0.51 (A2), 0.47 (A1B) and 0.36 m (B1) dynamic and steric SLR (both dynamic and steric); For just the Dynamic SLR: 0.15 m (B1), 0.20 m (A1B), 0.21 m (A2)	Not provided; uses multiple emission scenarios	Change in dynamic sea level is relative to 1981-2000; Uses GFDL CM2.1 under A1B scenario for mean projection of dynamic sea level; Global steric SLRs values for A1B (moderate emission scenario), B1 (lower emission scenario), A2 (higher emission scenario) emission scenarios; conservative estimate for land ice contribution	Yin et al. (2009)
Sea level rise (total)	Boston	For 2091-2100: 0.52 m (A2), 0.48 m (A1B), and 0.37 m (B1)	Not provided; uses multiple emission scenarios	Change in dynamic sea level is relative to 1981-2000; Uses GFDL CM2.1 under A1B scenario for mean projection of dynamic sea level; Global steric SLRs values for A1B (moderate emission scenario), B1 (lower emission scenario), A2 (higher emission scenario) emission scenarios; conservative estimate for land ice contribution	Yin et al. (2009)

Northeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Sea level rise (total)	Washington DC	For 2091-2100: 0.44 m (A2), 0.42 m (A1B) and 0.33 m (B1)	Not provided; uses multiple emission scenarios	Change in dynamic sea level is relative to 1981-2000; Uses GFDL CM2.1 under A1B scenario for mean projection of dynamic sea level; Global steric SLRs values for A1B (moderate emission scenario), B1 (lower emission scenario), A2 (higher emission scenario) emission scenarios; conservative estimate for land ice contribution	Yin et al. (2009)

Pacific Northwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
			2020-2040		
Temperature increase (mean annual)	Pacific Northwest (USGCRP region)	Mean increase of 2.2 degrees F (B1) and 2.2 degrees F (A2); likely range is 1.4 to 2.9 degrees F; very likely range is 0.7 to 3.7 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Pacific Northwest (USGCRP region)	Mean increase of 2.2 degrees F (B1) and 2.1 degrees F (A2); likely range is 1.4 to 3.0 degrees F; very likely range is 0.6 to 3.8 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (summer: JJA)	Pacific Northwest (USGCRP region)	Mean increase of 2.5 degrees F (B1) and 2.8 degrees F (A2); likely range is 1.6 to 3.7 degrees F; very likely range is 0.7 to 4.6 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Pacific Northwest (USGCRP region)	Mean increase of 1.9 degrees F (B1) and 1.7 degrees F (A2); likely range is 0.8 to 3.0 degrees F; very likely range is -0.2 to 4.1 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Pacific Northwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (fall: SON)	Pacific Northwest (USGCRP region)	Mean increase of 2.0 degrees F (B1) and 2.2 degrees F (A2); likely range is 1.4 to 3.0 degrees F for 2010-2029; very likely range is 0.7 to 3.6 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (mean seasonal)	Pacific Northwest (British Columbia, Washington, Oregon, Idaho, and portions of bordering states)	For 2020-2039: '+0.7 to 2 degrees C mean seasonal increase over winter across 5 locations with an approximate average of 1.25 degrees C	Not provided; one climate model with one emission scenario	A2 scenario; using an ECHAM5-MM5 regional model; Temperature increase at 2-m is relative to 1990 average;	Salathe et al (2007); information provided by Figure 8
Temperature increase (annual)	Pacific Northwest (WA, OR, ID, western Montana)	By 2020s (representing 2010 to 2040): low 0.4 degrees C (0.7 degrees F) average 1.1 degrees C (1.9 degrees F) high 1.8 degrees C (3.2 degrees F)	Not provided; 10 climate models and two emission scenarios	Two emission scenarios: B1 (Lower) and A2 (higher); relative to 1970-2000 average; 10 climate models; the low, high, and average of the 20 simulations (10 climate models, 2 scenarios) is provided; not downscaled but using 12-20 grid points directly from the climate models	Mote et al. (2005)
Temperature increase (annual)	Pacific Northwest (WA, OR, ID, western Montana)	2030: Mean increase of 2.1 degrees F (B1), and 2.5 degrees F (A1B), with an approximate range of 0.5 to 4.4 degrees F.	Very likely; 19 climate models bracketed with two emission scenarios	Reference period is 1970-1999; B1 emission scenario (lower emission scenario) and A1B emission scenario (moderate emission scenario); average of 19 global climate change models. Range is 5 to 95th percentile.	Mote and Salathe (2009), Figure 7, p. 30

Pacific Northwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (winter: DJF)	Pacific (USGCRP region)	Average change of 3.4% (B1) and 4.6% (A2); likely range is -3.2 to 12.3 % for 2010-2029; very likely range is -10.9 to 20.1% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Pacific (USGCRP region)	Average change of -6.4% (B1) and -7.2% (A2); likely range is -17.1 to 2.6 % for 2010-2029; very likely range is -26.9 to 12.4% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Pacific (USGCRP region)	Average change of 2.7% (B1) and 3.1% (A2); likely range is -1.4 to 6.9 % for 2010-2029; very likely range is -5.6 to 11.0% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (fall: SON)	Pacific (USGCRP region)	Average change of 4.3% (B1) and 3.6% (A2); likely range is -3.0 to 11.4% for 2010-2029; very likely range is -9.8 to 18.4% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Pacific Northwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (mean annual)	Pacific (USGCRP region)	Average change of 2.0% (B1) and 2.3% (A2); likely range is -1.9 to 6.5 % for 2010-2029; very likely range is -5.2 to 10.7% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Pacific Northwest (Washington, Oregon, Idaho, and portions of bordering states)	By 2020-2030: -1 to +1 mm / day in annual mean precipitation across the region; with central Washington receiving more rainfall, coast of Oregon receiving -0.5 mm / day less on average.	Not provided; one climate model and emission scenario	A2 scenario; using an ECHAM5-MM5 regional model, precipitation changes relative to 1990-1999 average	Salathe et al (2007); information provided by Figure 4,5
Precipitation	Pacific Northwest	By the 2040s: April 1 snowpack is projected to decline as much as 40% in the Cascades	Not provided	Business as usual emissions scenario evaluated with respect to a control climate scenario based on static 1995 emissions; statistical and regional downscaled data	Payne et al. (2004) as cited in USGCRP (2009)
Precipitation (annual)	Pacific Northwest (WA, OR, ID, western Montana)	By 2020s (2010 to 2040 average compared to 1970-2000 average): low -4% average +2% high +6%	Not provided; 10 climate models and two emission scenarios	Two emission scenarios: B1 (Lower) and A2 (higher); relative to 1970-2000 average; 10 climate models; the low, high, and average of the 20 simulations (10 climate models, 2 scenarios) is provided; not downscaled but using 12-20 grid points directly from the climate models	Mote et al. (2005)

Pacific Northwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
			2040-2070		
Temperature increase (mean annual)	Pacific Northwest (USGCRP region)	Mean increase of 3.6 degrees F (B1) and 4.3 degrees F (A2); likely range is 2.6 to 5.4 degrees F; very likely range is 1.6 to 6.4 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Pacific Northwest (USGCRP region)	Mean increase of 3.5 degrees F (B1) and 3.9 degrees F (A2); likely range is 2.3 to 5.2 degrees F; very likely range is 1.1 to 6.5 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (summer: JJA)	Pacific Northwest (USGCRP region)	Mean increase of 4.1 degrees F (B1) and 5.5 degrees F (A2); likely range is 3.0 to 6.9 degrees F; very likely range is 1.8 to 8.4 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Pacific Northwest (USGCRP region)	Mean increase of 3.1 degrees F (B1) and 3.4 degrees F (A2); likely range is 1.7 to 4.7 degrees F; very likely range is 0.3 to 6.1 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Pacific Northwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (fall: SON)	Pacific Northwest (USGCRP region)	Mean increase of 3.4 degrees F (B1) and 4.2 degrees F (A2); likely range is 2.5 to 5.3 degrees F; very likely range is 1.5 to 6.4 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (mean seasonal)	Pacific Northwest (Washington, Oregon, Idaho, and portions of bordering states)	By 2040-2055: +0 to 3 degrees C increase in seasonal temperature across the region over winter months; +0 to 2 degrees C over other months of the year	Not provided; one climate model and one emission scenario	A2 scenario; using an ECHAM5-MM5 regional model, temperature increase at 2-m is relative to 1989-1999 average	Salathe et al (2007); information provided from Figure 3
Temperature increase (annual)	Pacific Northwest (WA, OR, ID, western Montana)	By 2040s (compared to 1970-2000 average): low 0.8 degrees C (1.4 degrees F) average 1.6 degrees C (2.9 degrees F) high 2.6 degrees C (4.6 degrees F)	Not provided; 10 climate models and two emission scenarios	Two emission scenarios: B1 (Lower) and A2 (higher); relative to 1970-2000 average; 10 climate models; the low, high, and average of the 20 simulations (10 climate models, 2 scenarios) is provided; not downscaled but using 12-20 grid points directly from the climate models	Mote et al. (2005)
Temperature increase (annual)	Pacific Northwest (WA, OR, ID, western Montana)	By 2050: Mean increase of 3 degrees F (B1), and 4.4 degrees F (A1B), with an approximate range of 1.0 to 6.5 degrees F.	Very likely; 19 climate models for two emission scenarios	Reference period is 1970-1999; B1 emission scenario (lower emission scenario) and A1B emission scenario (moderate emission scenario); average of 19 climate models, statistically downscaled. Range is 5 to 95th percentile.	Mote and Salathe (2009), Figure 7, p. 30

Pacific Northwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (annual)	Pacific Northwest (WA, OR, ID, western Montana)	For 2030-2059: Mean increase of 1.68 degrees C (3.0 degrees F) for lower emission scenario and 2.24 degrees C (4.0 degrees F) for higher emission scenario.	Not provided. 19 climate models for two emission scenarios	Reference period is 1970-1999; B1 emission scenario (lower emission scenario) and A1B emission scenario (moderate emission scenario); average of 19 climate models.	Salathe et al (2009), Table 1, p. 48.
Temperature increase (annual)	Pacific Northwest (WA, OR, ID, western Montana)	For 2030-2059: Mean increase of 1.25 degrees C (2.25 degrees F) for lower emission scenario and 1.58 degrees C (2.84 degrees F) for higher emission scenario.	Not provided; one climate model with two emission scenarios	Reference period is 1970-1999; B1 emission scenario (lower emission scenario) and A1B emission scenario (moderate emission scenario); using the ECHAM5 climate model paired with the Weather Research and Forecasting regional model.	Salathe et al (2009), Table 1, p. 48.
Temperature increase (annual)	Pacific Northwest (WA, OR, ID, western Montana)	For 2030-2059: Mean increase of 2.1 degrees C (3.7F degrees F) for lower emission scenario and 2.41 degrees C (4.34 degrees F) for higher emission scenario.	Not provided; one climate model with two emission scenarios	Reference period is 1970-1999; B1 emission scenario (lower emission scenario) and A1B emission scenario (moderate emission scenario); using the CCSM3 climate model paired with the Weather Research and Forecasting regional model.	Salathe et al (2009), Table 1, p. 48.
Extreme heat event	Pacific Northwest (WA, OR, ID, western Montana)	By mid-century (2030-2059): 7 to 20% increase in frequency of warm nights across the region (i.e., nights with minimum temperatures above the 90th percentile).	Not provided; two climate models with two emission scenarios	Reference period is 1970-1999; A1B emission scenario. CCSM3 and ECHAM5 with the Weather Research and Forecasting regional model.	Salathe et al (2009), p62 and Figure 10, p. 61.
Extreme heat event	Pacific Northwest (WA, OR, ID, western Montana)	By mid-century (2030-2059): 0.1 to 3.5 additional heat waves annually (episode with 3 or more days > 32 degrees C) across the region; greatest increase in south-central Washington and Western low lands.	Not provided; two climate models with two emission scenarios	Reference period is 1970-1999; A1B emission scenario. CCSM3 and ECHAM5 with the Weather Research and Forecasting regional model.	Salathe et al (2009), p62 and Figure 11, p. 61.

Pacific Northwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (winter: DJF)	Pacific (USGCRP region)	Average change of 4.8% (B1) and 7.4% (A2); likely range is -2.7 to 17.3% for 2040-2059; very likely range is -12.3 to 27.2% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Pacific (USGCRP region)	Average change of -8.1% (B1) and -16.9% (A2); likely range is -28.3 to 1.2% for 2040-2059; very likely range is -39.6 to 10.4% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Pacific (USGCRP region)	Average change of 4.9% (B1) and 2.8% (A2); likely range is -2.7 to 10.1% for 2040-2059; very likely range is -8.3 to 15.4% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (fall: SON)	Pacific (USGCRP region)	Average change of 4.5% (B1) and 5.3% (A2); likely range is -2.7 to 13.3% for 2040-2059; very likely range is -10.7 to 21.3% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Pacific Northwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (mean annual)	Pacific (USGCRP region)	Average change of 2.8% (B1) and 2.4% (A2); likely range is -3.7 to 8.5% for 2040-2059; very likely range is -9.8 to 14.6% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean seasonal)	Western United States (corresponds to our Pacific Northwest, Great Plains, Southwest)	2040-2060: changes small except for June-July-August, where precipitation was reduced by more than 20%	Not provided; one climate model with one emission scenario	PCM climate model with the MM5; three MM5 ensemble simulations where the initial/boundary conditions are varied; IPCC Business As Usual emission scenario between 1995 and 2100;	Leung et al. (2004)
Precipitation (mean annual)	Pacific Northwest (Washington, Oregon, Idaho, and portions of bordering states)	By 2045-2055: -1 to +1.5 mm / day in annual mean precipitation across the region; with central Washington receiving more rainfall, coast of Oregon receiving -0.5 mm / day less on average. In fall and spring: +1.5 mm / day in seasonal precipitation in central Washington and interior of Oregon.	Not provided; one climate model with one emission scenario	A2 scenario; using an ECHAM5-MM5 regional model, precipitation changes relative to 1989-1999 average	Salathe et al (2007); information provided from Figure 4, 5
Precipitation (annual)	Pacific Northwest (WA, OR, ID, western Montana)	By 2040s: low -4% average +2% high +9%	Not provided; 10 climate models with two emission scenarios	Two emission scenarios: B1 (Lower) and A2 (higher); relative to 1970-2000 average; 10 climate models; the low, high, and average of the 20 simulations (10 climate models, 2 scenarios) is provided; not downscaled but using 12-20 grid points directly from the climate models	Mote et al. (2005)

Pacific Northwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (annual)	Pacific Northwest (WA, OR, ID, western Montana)	For 2050: Average change of 2% (B1 scenario) and 4% (A1B scenario) with a range of -15% to 22%	Very likely; 19 climate models for two emission scenarios	Reference period is 1970-1999; B1 emission scenario (lower emission scenario) and A1B emission scenario (moderate emission scenario); average of 19 global climate change models. Range is 5 to 95th percentile.	Mote and Salathe (2009), Figure 7, p. 30
Precipitation (annual)	Pacific Northwest (WA, OR, ID, western Montana)	For 2030 to 2059: Average change of 2.0% (B1) and 1.9% (A1B).	Not provided; 19 climate models for two emission scenarios	Reference period is 1970-1999; B1 emission scenario (lower emission scenario) and A1B emission scenario (moderate emission scenario); average of 19 climate models.	Salathe et al (2009), Table 1, p. 48.
Precipitation (annual)	Pacific Northwest (WA, OR, ID, western Montana)	For 2030 to 2059: Average change of 5.9% (B1) and 3.0% (A1B).	Not provided; one climate model with two emission scenarios	Reference period is 1970-1999; B1 emission scenario (lower emission scenario) and A1B emission scenario (moderate emission scenario); using the ECHAM5 climate model paired with the Weather Research and Forecasting regional model.	Salathe et al (2009), Table 1, p. 48.
Precipitation (annual)	Pacific Northwest (WA, OR, ID, western Montana)	For 2030- 2059: Average change of -4.0% (B1) and -3.2% (A1B).	Not provided; one climate model with two emission scenarios	Reference period is 1970-1999; B1 emission scenario (lower emission scenario) and A1B emission scenario (moderate emission scenario); using the CCSM3 climate model paired with the Weather Research and Forecasting regional model.	Salathe et al (2009), Table 1, p. 48.

Pacific Northwest

Climate Variable	U.S. Region	Projection	Certainty	Modeling Parameters	References
Extreme precipitation event	Pacific Northwest (WA, OR, ID, western Montana)	By mid-century (2030-2059): precipitation intensity (total annual precipitation divided by number of wet days with precipitation exceeding 1 mm) is "positive or very small over the entire state with considerable increases only over the northwestern portion of the state."	Not provided; two climate models with one emission scenario	Reference period is 1970-1999; A1B emission scenario. CCSM3 and ECHAM5 with the Weather Research and Forecasting regional model.	Salathe et al (2009), page 62 and Figure 11, page 63
Extreme precipitation event	Pacific Northwest (WA, OR, ID, western Montana)	By mid-century (2030-2059); fraction of precipitation falling on days where precipitation exceeds 20th century 95th percentile increases in western and eastern portions of Washington, slight decreases in central Washington (ECHAM5-WRF); CCSM3-WRF is similar with some locations receiving a greater fractional change.	Not provided; two climate models with one emission scenario	Reference period is 1970-1999; A1B emission scenario. CCSM3 and ECHAM5 with the Weather Research and Forecasting regional model.	Salathe et al (2009), page 62 and Figure 12, page 63
Sea level rise	Washington state	For the mid-century (2050): “very low” SLR estimate: -12 cm (-5"): NW Olympic Peninsula 3 cm (1"): Central/Southern Coast 8 cm (3"): Puget Sound	Not provided; based on varying methods	Combines B1 emission scenario, higher estimates of ice loss from Greenland and Antarctica, seasonal changes in atmospheric circulation, vertical land deformation	Mote et al. (2008), for advisory purposes
Sea level rise	Washington state	For the mid-century (2050): “medium” SLR estimate: 0 cm (0"): NW Olympic Peninsula 12.5 cm (5"): Central/Southern Coast 15 cm (6"): Puget Sound	Not provided; based on varying methods	Combines the average of 6 central values from 6 IPCC emission scenarios, higher estimates of ice loss from Greenland and Antarctica, seasonal changes in atmospheric circulation, vertical land deformation	Mote et al. (2008), for advisory purposes

Pacific Northwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Sea level rise	Washington state	For the mid-century (2050): "very high" SLR estimate: 35 cm (14"):NW Olympic Peninsula 45 cm (18"): Central/Southern Coast 55 cm (22"): Puget Sound	Not provided; based on varying methods	Combines the A1Fi emission scenario, higher estimates of ice loss from Greenland and Antarctica, seasonal changes in atmospheric circulation, vertical land deformation	Mote et al. (2008), for advisory purposes
2070-2100					
Temperature increase (mean annual)	Pacific Northwest (USGCRP region)	Mean increase of 5.1 degrees F (B1) and 8.3 degrees F (A2); likely range is 3.7 to 10.0 degrees F; very likely range is 2.3 to 11.8 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Pacific Northwest (USGCRP region)	Mean increase of 5.1 degrees F (B1) and 7.6 degrees F (A2); likely range is 3.5 to 9.5 degrees F; very likely range is 1.8 to 11.4 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (summer: JJA)	Pacific Northwest (USGCRP region)	Mean increase of 5.8 degrees F (B1) and 10.5 degrees F (A2); likely range is 4.2 to 13.1 degrees F; very likely range is 2.5 to 15.7 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Pacific Northwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (spring: MAM)	Pacific Northwest (USGCRP region)	Mean increase of 4.4 degrees F (B1) and 6.6 degrees F (A2); likely range is 2.5 to 8.9 degrees F; very likely range is 0.6 to 11.2 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (fall: SON)	Pacific Northwest (USGCRP region)	Mean increase of 4.8 degrees F (B1) and 8.4 degrees F (A2); likely range is 3.5 to 10.2 degrees F; very likely range is 2.1 to 11.9 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (mean seasonal)	Pacific Northwest (Washington, Oregon, Idaho, and portions of bordering states)	By 2090-2100: + 3 to 5 degrees C mean seasonal temperature across the region over winter months	Not provided; one climate model with one emission scenario	A2 scenario; using an ECHAM5-MM5 regional model; Temperature increase at 2-m is relative to 1989-1999 average	Salathe et al (2007); see Figure 3
Temperature increase (annual)	Pacific Northwest (WA, OR, ID, western Montana)	By 2080s (compared to 1970 to 2000 average): low 1.6 degrees C (2.9 degrees F) average 3.1 degrees C (5.6 degrees F) high 4.9 degrees C (8.8 degrees F)	Not provided; 10 climate models and two emission scenarios	Two emission scenarios: B1 (Lower) and A2 (higher); relative to 1970-2000 average; 10 climate models; the low, high, and average of the 20 simulations (10 climate models, 2 scenarios) is provided; not downscaled but using 12-20 grid points directly from the climate models	Mote et al. (2005)

Pacific Northwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (annual)	Pacific Northwest (WA, OR, ID, western Montana)	2090: Mean increase of 4.8 degrees F (B1) and 6.8 degrees F, with an approximate range of 4 to 9.7 degrees F.	Very likely; 19 climate models for two emission scenarios	Reference period is 1970-1999; B1 emission scenario (lower emission scenario) and A1B emission scenario (moderate emission scenario); average of 19 global climate change models, statistically downscaled. Range is 5 to 95th percentile.	Mote and Salathe (2009), Figure 7, p. 30
Extreme heat event	Pacific (USGCRP region)	By late-century (2080-2099): 1-in-20-year extreme heat event (combination of high temperature and humidity) is projected to occur every 1 to 2 years	Not provided; multiple climate models with one emission scenario	A2 scenario; change in frequency of 1-in-20-year extreme heat events is relative to today	CMIP3-A (2008) as cited in USGCRP 2009
Precipitation (winter: DJF)	Pacific (USGCRP region)	Average change of 7.8% (B1) and 14.5% (A2); likely range is -1.1 to 28.6 % for 2080-2098; very likely range is -13.9 to 42.8% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Pacific (USGCRP region)	Average change of -10.8% (B1) and -21.9% (A2); likely range is -41.9 to -0.9% for 2080-2098; very likely range is -62.0 to 18.2% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Pacific Northwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (spring: MAM)	Pacific (USGCRP region)	Average change of 5.2% (B1) and 6.6% (A2); likely range is -1.8 to 15.0% for 2080-2098; very likely range is -10.2 to 23.4% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (fall: SON)	Pacific (USGCRP region)	Average change of 7.4% (B1) and 8.6% (A2); likely range is -6.5 to 23.6% for 2080-2098; very likely range is -21.6 to 38.7% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Pacific (USGCRP region)	Average change of 4.3% (B1) and 5.9% (A2); likely range is -4.1 to 15.8 % for 2080-2098; very likely range is -14.1 to 25.8% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Pacific Northwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (extreme events)	Pacific Northwest	For 2071-2095: Peak anomalies in extreme precipitation event frequency of up to 10 days/year (up to 140%); Possible weakening of rainshadow effect in Mountain West; Positive anomalies in mean annual precipitation on lee side of high elevations in eastern Washington, eastern Oregon, Nevada, and eastern Idaho associated also with large changes in extreme-even frequency and contribution; However, in central Montana and central Wyoming, positive anomalies in mean annual precipitation were associated with negative changes in frequencies of dry days (-26 days a year, or -12%); Meaning traditionally dry areas in rainshadow will get wetter	Not provided; results of one model and emission scenario	Regional model (RegCM3) using a baseline period of 1961 through 1985; A2 emission scenario	Diffenbaugh et al (2005), page 15775
Precipitation (mean annual)	Pacific Northwest (Washington, Oregon, Idaho, and portions of bordering states)	For 2090-2100: -1.5 to 0 mm / day in annual mean precipitation across the region; largest change along coast and interior of Oregon	Not provided; result of one regional model with one emission scenario	A2 scenario; using an ECHAM5-MM5 regional model, precipitation changes relative to 1989-1999 average	Salathe et al (2007); see Figure 4, 5

Pacific Northwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (annual)	Pacific Northwest (WA, OR, ID, western Montana)	By 2080s: low -2% average +6% high +18%	Not provided; 10 climate models with two emission scenarios	Two emission scenarios: B1 (Lower) and A2 (higher); relative to 1970-2000 average; 10 climate models; the low, high, and average of the 20 simulations (10 climate models, 2 scenarios) is provided; not downscaled but using 12-20 grid points directly from the climate models	Mote et al. (2005)
Precipitation (annual)	Pacific Northwest (WA, OR, ID, western Montana)	By 2100: Average change of 4% (B1 scenario) and 8% (A1B scenario) with a range of -14% to 17%	Very likely; 19 climate models bracketed with two emission scenarios	Reference period is 1970-1999; B1 emission scenario (lower emission scenario) and A1B emission scenario (moderate emission scenario); average of 19 global climate change models, statistically downscaled. Range is 5 to 95th percentile.	Mote and Salathe (2009), Figure 7, p. 30
Sea level rise	Washington state	For the end-of-century (2100): “very low” SLR estimate: -24 cm (-9"): NW Olympic Peninsula 6 cm (2"): Central/Southern Coast 16 cm (6"): Puget Sound	Not provided; based on varying methods	Combines B1 emission scenario, higher estimates of ice loss from Greenland and Antarctica, seasonal changes in atmospheric circulation, vertical land deformation	Mote et al. (2008), for advisory purposes
Sea level rise	Washington state	For the end-of-century (2100): “medium” SLR estimate: 4 cm (2"): NW Olympic Peninsula 29 cm (11"): Central/Southern Coast 34 cm (13"): Puget Sound	Not provided; based on varying methods	Combines the average of 6 central values from 6 IPCC emission scenarios, higher estimates of ice loss from Greenland and Antarctica, seasonal changes in atmospheric circulation, vertical land deformation	Mote et al. (2008), for advisory purposes

Pacific Northwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Sea level rise	Washington state	For the end-of-century (2100) “very high” SLR estimate: 88 cm (35"): NW Olympic Peninsula 108 cm (43"): Central/Southern Coast 128 cm (50"): Puget Sound	Not provided; based on varying methods	Combines the A1Fi emission scenario, higher estimates of ice loss from Greenland and Antarctica, seasonal changes in atmospheric circulation, vertical land deformation	Mote et al. (2008), for advisory purposes

Southwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
			2020-2040		
Temperature increase (mean annual)	Southwest (USGCRP region)	Mean increase of 2.3 degrees F (B1) and 2.4 degrees F (A2); likely range is 1.7 to 3.0 degrees F for 2010-2029; very likely range is 1.0 to 3.7 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Southwest (USGCRP region)	Mean increase of 2.2 degrees F (B1) and 2.1 degrees F (A2); likely range is 1.4 to 3.0 degrees F for 2010-2029; very likely range is 0.6 to 3.8 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (summer: JJA)	Southwest (USGCRP region)	Mean increase of 2.6 degrees F (B1) and 2.7 degrees F (A2); likely range is 1.8 to 3.4 degrees F for 2010-2029; very likely range is 1.1 to 4.2 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Southwest (USGCRP region)	Mean increase of 2.2 degrees F (B1) and 2.1 degrees F (A2); likely range is 1.3 to 3.1 degrees F for 2010-2029; very likely range is 0.4 to 4.0 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Southwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (fall: SON)	Southwest (USGCRP region)	Mean increase of 2.3 degrees F (B1) and 2.4 degrees F (A2); likely range is 1.7 to 3.0 degrees F for 2010-2029; very likely range is 1.1 to 3.6 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (winter: DJF)	Southwest (USGCRP region)	Average change of 2.1% (B1) and 4.0% (A2); likely range is -6.0 to 14.0% for 2010-2029; very likely range is -16.0 to 24.0% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Southwest (USGCRP region)	Average change of -4.8% (B1) and -3.9% (A2); likely range is -13.7 to 4.1% for 2010-2029; very likely range is -22.6 to 13.0% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Southwest (USGCRP region)	Average change of -3.8% (B1) and -4.6% (A2); likely range is -9.9 to 2.2% for 2010-2029; very likely range is -15.7 to 8.1% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Southwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (fall: SON)	Southwest (USGCRP region)	Average change of -0.2% (B1) and -0.6% (A2); likely range is -5.9 to 5.6% for 2010-2029; very likely range is -11.7 to 11.3% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Southwest (USGCRP region)	Average change of -1.2% (B1) and -0.6% (A2); likely range is -5.5 to 4.0% for 2010-2029; very likely range is -9.9 to 8.7% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Pacific Southwest (125 to 95 degrees W; 25 to 40 degrees N)	By 2020-2030: Range from 0 to -0.05 mm / day change in annual mean precipitation minus evaporation; Mean change is -0.025 mm / day in annual mean precipitation minus evaporation	Range of values given represents 25% and 75% percentiles of results from 19 different models; results are for one emission scenario	A1B emissions scenario; precipitation changes are relative to 1950-2000; 19 models	Seager et al (2007)

Southwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Sea level rise (extreme events)	San Francisco	By 2005-2034: Number of extreme sea level rise events increases from one per year currently to 1.3 events per year	Projections depend upon assumed rate of sea level rise between 2000-2100.	A2 scenario. "Extreme event" is the number of hourly events that exceed the historical (1960-1978) 99.99th percentile (i.e, greater than 141 cm mean sea level); Includes tides, weather, and monthly and interannual sea level fluctuations from El Nino / Southern Oscillations Assumes a 30 cm increase in mean sea level by 2070-2100, consistent with sea level projections under A2 emissions scenario	Cayan et al. (2008)
2040-2070					
Temperature increase (mean annual)	Southwest (USGCRP region)	Mean increase of 3.6 degrees F (B1) and 4.5 degrees F (A2); likely range is 2.6 to 5.5 degrees F for 2040-2059; very likely range is 1.6 to 6.4 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Southwest (USGCRP region)	Mean increase of 3.2 degrees F (B1) and 3.9 degrees F (A2); likely range is 2.0 to 5.1 degrees F for 2040-2059; very likely range is 0.8 to 6.2 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Southwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (summer: JJA)	Southwest (USGCRP region)	Mean increase of 4.1 degrees F (B1) and 5.3 degrees F (A2); likely range is 3.1 to 6.5 degrees F for 2040-2059; very likely range is 2.1 to 7.7 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Southwest (USGCRP region)	Mean increase of 3.5 degrees F (B1) and 4.1 degrees F (A2); likely range is 2.1 to 5.2 degrees F for 2040-2059; very likely range is 0.8 to 6.3 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (fall: SON)	Southwest (USGCRP region)	Mean increase of 3.7 degrees F (B1) and 4.6 degrees F (A2); likely range is 2.8 to 5.4 degrees F for 2040-2059; very likely range is 2.0 to 6.2 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature (mean annual)	California	For 2050: roughly 1 to 3 degrees Celsius (1.8 to 5.4 degrees F) increase in mean annual temperature	Not provided; 6 climate models with two emission scenarios	Downscaled 6 climate models (CNRM CM3, GFDL CM2.1, MIROC3.2, MPI ECHAM5, NCAR CCSM3, NCAR PCM1), A2 (higher emission scenario) and B1 (lower emission scenario) scenarios, Reference period of 1961-1990	Cayan et al (2009)

Southwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (winter: DJF)	Southwest (USGCRP region)	Average change of 1.4% (B1) and 5.2% (A2); likely range is -6.1 to 16.2% for 2040-2059; very likely range is -16.7 to 27.2% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Southwest (USGCRP region)	Average change of -4.5% (B1) and -7.5% (A2); likely range is -21.7 to 6.8% for 2040-2059; very likely range is -36.0 to 21.1% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Southwest (USGCRP region)	Average change of -6.0% (B1) and -10.2% (A2); likely range is -20.4 to -0.1% for 2040-2059; very likely range is -30.6 to 10.1% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (fall: SON)	Southwest (USGCRP region)	Average change of -1.9% (B1) and -3.3% (A2); likely range is -11.4 to 5.3% for 2040-2059; very likely range is -19.5 to 12.9% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Southwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (mean annual)	Southwest (USGCRP region)	Average change of -2.2% (B1) and -2.5% (A2); likely range is -10.8 to 5.9% for 2040-2059; very likely range is -19.1 to 14.2% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (snow)	Western United States (Cascades and Sierra)	For 2040-2060: 60-70% reduction in snowpack	Not provided; one climate model and emission scenario	PCM climate model with the MM5; three MM5 ensemble simulations where the initial/boundary conditions are varied; IPCC Business As Usual emission scenario between 1995 and 2100;	Leung et al. (2004)
Precipitation (mean annual)	Pacific Southwest (125 to 95 degrees W; 25 to 40 degrees N)	For 2040-2060: Range from -0.025 to -0.075 mm / day change in annual mean precipitation minus evaporation; Mean change is -0.05 mm / day in annual mean precipitation minus evaporation	Range of values given represents 25% and 75% percentiles of results from 19 different models for one emission scenario	A1B emissions scenario; precipitation changes are relative to 1950-2000; Uses 19 climate model results from the IPCC AR4	Seager et al (2007)
Precipitation (extreme events)	Western United States (Cascades and Sierra)	For 2040-2060: Increased by up to 10 mm/day (15-20% increase in those areas)	Not provided; one climate model and one emission scenario	PCM climate model with the MM5; three MM5 ensemble simulations where the initial/boundary conditions are varied; IPCC Business As Usual emission scenario between 1995 and 2100;	Leung et al. (2004)

Southwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (extreme events)	Western United States (Rockies)	For 2040-2060: 15-30% increase in extreme precipitation over the Northern Rockies	Not provided; one climate model and one emission scenario	PCM climate model with the MM5; three MM5 ensemble simulations where the initial/boundary conditions are varied; IPCC Business As Usual emission scenario between 1995 and 2100;	Leung et al. (2004)
Precipitation (in the form of rain, not snow)	Western United States (corresponds to our Pacific Northwest, Great Plains, Southwest)	For 2040-2060: More precipitation in form of rain rather than snow (10-20% reduction in snowfall in the CRB and over 30% reduction in SSJ basin)	Not provided; one climate model and one emission scenario	PCM climate model with the MM5; three MM5 ensemble simulations where the initial/boundary conditions are varied; IPCC Business As Usual emission scenario between 1995 and 2100;	Leung et al. (2004)
Snow storage	Sierra Nevada, California	For 2035-2064: amount of water as snow on April 1 is projected to decrease by 32 to 79% at all elevations	Not provided; 3 climate models with two emission scenarios	Reference period is 1961-1990; downscaling of three global climate models (Centre Nati onal de Recherches Météorologiques C M3, Geophysical Fluid Dynamics Labor atory CM21 and National Center for At mospheric Research PCM2); A2 (higher emission scenario) and B1 (lower emission scenario) emission scenarios	Cayan et al (2008) as cited in PPIC 2008
Sea level rise	California	By 2050: range of increase of 12 to 18 in	Not provided; 6 climate models with two emission scenarios	Downscaled 6 climate models (CNRM CM3, GFDL CM2.1, MIROC3.2, MPI ECHAM5, NCAR CCSM3, NCAR PCM1), A2 (higher emission scenario) and B1 (lower emission scenario) scenarios, Reference period of 1961-1990; includes Rahmstorf 2007 method	Cayan et al (2009)

Southwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Sea leve rise (extreme events)	San Francisco	Mid-century (2035-2065): Number of extreme sea level rise events increases from one per year currently to 7 events per year	Not provided; Projections depend upon assumed rate of sea level rise between 2000 - 2100	A2 scenario, "Extreme event" is the number of hourly events that exceed the historical (1960-1978) 99.99th percentile (i.e, greater than 141 cm mean sea level); Includes tides, weather, and monthly and interannual sea level fluctuations from El Nino / Southern Oscillations Assumes a 30 cm increase in mean sea level by 2070-2100, consistent with sea level projections under A2 emissions scenario	Cayan et al. (2008)
2070-2100					
Temperature increase (mean annual)	Southwest (USGCRP region)	Mean increase of 5.2 degrees F (B1) and 8.7 degrees F (A2); likely range is 3.8 to 10.2 degrees F for 2080-2098; very likely range is 2.5 to 11.8 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Southwest (USGCRP region)	Mean increase of 4.8 degrees F (B1) and 7.6 degrees F (A2); likely range is 3.3 to 9.4 degrees F for 2080-2098; very likely range is 1.8 to 11.3 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Southwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (summer: JJA)	Southwest (USGCRP region)	Mean increase of 5.6 degrees F (B1) and 9.7 degrees F (A2); likely range is 4.2 to 11.6 degrees F for 2080-2098; very likely range is 2.8 to 13.5 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Southwest (USGCRP region)	Mean increase of 4.9 degrees F (B1) and 8.0 degrees F (A2); likely range is 3.3 to 9.9 degrees F for 2080-2098; very likely range is 1.7 to 11.8 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (fall: SON)	Southwest (USGCRP region)	Mean increase of 5.3 degrees F (B1) and 9.2 degrees F (A2); likely range is 4.0 to 10.6 degrees F for 2080-2098; very likely range is 2.8 to 12.0 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature (mean annual)	California	By 2100: roughly 2 degrees C (3.6 degrees F) (lower emission scenario) to 5 degrees Celsius (9 degrees F) (higher emission scenario)	Not provided; 6 climate models with two emission scenarios	Downscaled 6 climate models (CNRM CM3, GFDL CM2.1, MIROC3.2, MPI ECHAM5, NCAR CCSM3, NCAR PCM1), A2 (higher emission scenario) and B1 (lower emission scenario), Reference period of 1961-1990	Cayan et al (2009)

Southwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature (seasonal)	California	By 2100: winter increase of 1 degrees C (1.8 degrees F) (lower emission scenario) to 4 degrees C (7.2 degrees F) (higher emission scenario) and summer increase of 1.5 degrees C (2.7 degrees F) (lower emission scenario) to 6 degrees C (10.8 degrees F) (higher emission scenario)	Not provided; 6 climate models with two emission scenarios	Downscaled 6 climate models (CNRM CM3, GFDL CM2.1, MIROC3.2, MPI ECHAM5, NCAR CCSM3, NCAR PCM1), A2 (higher emission scenario) and B1 (lower emission scenario) scenarios, Reference period of 1961-1990	Cayan et al (2009)
Temperature anomalies (hot days)	Southwestern US (region not defined)	For 2071-2095: Peak change in high temperature anomalies is up to 100 days per year (560%)	Not provided; one climate model and one emission scenario	Regional model (RegCM3) using a baseline period of 1961 through 1985; A2 emission scenario for 2071-2095	Diffenbaugh et al 2005, page 15775
Temperature anomalies (hot days)	Utah (central)	For 2071-2095: Area of US which is predicted to get a particularly large amount of hot day anomalies - up to 400% (ie 4x the hot event frequency observed in the past, where hot event is defined as 95th percentile) (up to 2095)	Not provided; one climate model and one emission scenario	Regional model (RegCM3) using a baseline period of 1961 through 1985; A2 emission scenario for 2071-2095	Diffenbaugh et al 2005, page 15775
Temperature anomalies (hot days)	California (high elevation areas)	For 2071-2095: Area of the US which is predicted to get a particularly large amount of hot day anomalies - up to 400% (ie 4x the hot event frequency observed in the past, where hot event is defined as 95th percentile) (up to 2095)	Not provided; one climate model and one emission scenario	Regional model (RegCM3) using a baseline period of 1961 through 1985; A2 emission scenario for 2071-2095	Diffenbaugh et al 2005, page 15775

Southwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (winter: DJF)	Southwest (USGCRP region)	Average change of 1.9% (B1) and 5.0% (A2); likely range is -12.5 to 22.6% for 2080-2098; very likely range is -30.0 to 40.1% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Southwest (USGCRP region)	Average change of -2.6% (B1) and -5.4% (A2); likely range is -24.2 to 13.3% for 2080-2098; very likely range is -42.9 to 32.1% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Southwest (USGCRP region)	Average change of -7.0% (B1) and -19.2% (A2); likely range is -32.1 to 1.1% for 2080-2098; very likely range is -45.0 to 9.2% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (fall: SON)	Southwest (USGCRP region)	Average change of -0.3% (B1) and -1.1% (A2); likely range is -14.5 to 12.4% for 2080-2098; very likely range is -28.0 to 25.8% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Southwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (mean annual)	Southwest (USGCRP region)	Average change of -1.6% (B1) and -4.2% (A2); likely range is -15.7 to 7.4% for 2080-2098; very likely range is -27.3 to 19.0% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Pacific Southwest	Range from -0.15 to -0.025 mm / day change in annual mean precipitation minus evaporation by 2080-2100; Mean change is -0.075 mm / day in annual mean precipitation minus evaporation	Range of values given represents 25% and 75% percentiles of results from 19 different models	A1B emissions scenario; precipitation changes are relative to 1950-2000; Uses 19 climate model results from the IPCC AR4	Seager et al (2007)
Sea level rise (total)	California (high elevation areas)	By 2070 to 2099: sea level rise projected to range from 11 to 54 cm (4.3 to 21 in) (B1); 14 to 61 cm (5.5 to 24 in) (A2), and 17 to 72 cm (6.7 to 28 in) (A1); Also, mean sea level rise from a survey of several climate models was determined to range from approximately 10 to 80 cm (3.9 to 31.5 in) between 2000 and 2100	Not provided	Mean sea level rise provided by GFDL CM2.1 and PCM was determined to range from approximately 10 to 80 cm (3.9 to 31.5 in) between 2000 and 2100; includes predicted astronomical tides with projected weather forcing, El Nino related variability, secular SLR; Reference year of 2000	Cayan et al. (2008)

Southwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Sea level rise (extreme events)	San Francisco	For 2070-2100: Number of extreme sea level rise events increases from one per year currently to 17 events per year	Projections depend upon assumed rate of sea level rise between 2000 - 2100	A2 scenario, "Extreme Sea Level Rise event" is the number of hourly events that exceed the historical (1960-1978) 99.99th percentile (i.e, greater than 141 cm mean sea level); Includes tides, weather, and monthly and interannual sea level fluctuations from El Nino / Southern Oscillations Assumes a 30 cm increase in mean sea level by 2070-2100, consistent with sea level projections under A2 emissions scenario	Cayan et al. (2008)
Sea level rise	California	By 2100: increase of 21 to 55 in	Not provided; 6 climate models with two emission scenarios	Downscaled 6 climate models (CNRM CM3, GFDL CM2.1, MIROC3.2, MPI ECHAM5, NCAR CCSM3, NCAR PCM1), A2 (higher emission scenario) and B1 (lower emission scenario), Reference period of 1961-1990; includes Rahmstorf 2007 method	Cayan et al (2009)

Great Plains					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
2020-2040					
Temperature increase (mean annual)	Great Plains (USGCRP region)	Mean increase of 2.5 degrees F (B1) and 2.4 degrees F (A2); likely range is 1.8 to 3.1 degrees F for 2010-2029; very likely range is 1.1 to 3.8 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Great Plains (USGCRP region)	Mean increase of 2.5 degrees F (B1) and 2.2 degrees F (A2); likely range is 1.4 to 3.4 degrees F for 2010-2029; very likely range is 0.6 to 4.2 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (summer: JJA)	Great Plains (USGCRP region)	Mean increase of 2.7 degrees F (B1) and 2.9 degrees F (A2); likely range is 1.8 to 3.7 degrees F for 2010-2029; very likely range is 0.8 to 4.6 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Great Plains (USGCRP region)	Mean increase of 2.2 degrees F (B1) and 1.9 degrees F (A2); likely range is 1.2 to 3.0 degrees F for 2010-2029; very likely range is 0.5 to 3.9 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Great Plains					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (fall: SON)	Great Plains (USGCRP region)	Mean increase of 2.4 degrees F (B1) and 2.5 degrees F (A2); likely range is 1.8 to 3.3 degrees F for 2010-2029; very likely range is 1.1 to 4.0 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature Increase (mean annual)	Texas	For 2025 to 2035: +1.25 degree C change in average annual temperature	Not provided; one climate model and emission scenario.	A1B emission scenario; temperature change is relative to 1971-1995; CCSM3 driving regional model, RegCM3.1	Wu (2008)
Precipitation (winter: DJF)	Great Plains (USGCRP region)	Average change of 2.6% (B1) and 3.3% (A2); likely range is -1.5 to 6.8% for 2010-2029; very likely range is -5.6 to 10.9% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Great Plains (USGCRP region)	Average change of -3.1% (B1) and -2.2% (A2); likely range is -8.8 to 4.4% for 2010-2029; very likely range is -15.4 to 11.0% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Great Plains (USGCRP region)	Average change of 2.2% (B1) and 0.9% (A2); likely range is -2.8 to 5.8% for 2010-2029; very likely range is -6.6to 9.4% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Great Plains					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (fall: SON)	Great Plains (USGCRP region)	Average change of 0.1% (B1) and 0.4% (A2); likely range is -5.2 to 6.0% for 2010-2029; very likely range is -10.8 to 11.7% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Great Plains (USGCRP region)	Average change of 0.1% (B1) and 0.3% (A2); likely range is -3.1 to 3.3 for 2010-2029; very likely range is -6.3 to 6.5% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Average precipitation (mean annual)	Great Plains (MT, ND, SD, WY, NE, CO, KS, NM, OK, TX)	Averaged for 2025 to 2034 time period, variation of (-7.0) to +5.0 in across the region	Not provided; two climate models and one scenario	Uses two models the CFCMI and HADCM2 models with baseline period (1961-1990), concentrations increasing by 1% per year after 1989 and including the effects of sulfate aerosols	Ojima, D. and J.M. Lackett (2002)
Precipitation (mean annual)	Texas	By 2025-2035: +3.15 in annual precipitation Northeastern and central parts of Texas (particularly the Brazos River Basin) will receive the most precipitation. Gulf Coast area and western Texas will receive less precipitation, on average, than currently	Not provided; one climate model and emission scenario	A1B emission scenario; temperature change is relative to 1971-1995; CCSM3 driving regional model, RegCM3.1,	Wu (2008)

Great Plains					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
2040-2070					
Temperature increase (mean annual)	Great Plains (USGCRP region)	Mean increase of 3.8 degrees F (B1) and 4.7 degrees F (A2); likely range is 2.7 to 5.8 degrees F for 2040-2059; very likely range is 1.6 to 6.9 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Great Plains (USGCRP region)	Mean increase of 3.6 degrees F (B1) and 4.3 degrees F (A2); likely range is 2.4 to 5.6 degrees F for 2040-2059; very likely range is 1.2 to 6.9 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (summer: JJA)	Great Plains (USGCRP region)	Mean increase of 4.3 degrees F (B1) and 5.6 degrees F (A2); likely range is 3.0 to 7.1 degrees F for 2040-2059; very likely range is 1.7 to 8.7 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Great Plains (USGCRP region)	Mean increase of 3.4 degrees F (B1) and 4.0 degrees F (A2); likely range is 2.1 to 5.5 degrees F for 2040-2059; very likely range is 0.8 to 6.9 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Great Plains					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (fall: SON)	Great Plains (USGCRP region)	Mean increase of 3.8 degrees F (B1) and 4.7 degrees F (A2); likely range is 2.7 to 5.7 degrees F for 2040-2059; very likely range is 1.6 to 6.7 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (mean seasonal)	Northern Great Plains (ND, SD, part of MT, NE, IA, WI, IL, WY)	Averaged over 2041 to 2060, +3 to 4 degrees C in winter and spring	Not provided; across different CRCM simulations for one emission scenario	Reference period of 1971-1990 and future (2041-60) using CRCM; Scenario used is a modified version of the IS92a scenario, A2 scenario;	Plummer et al. (2005)
Precipitation (winter: DJF)	Great Plains (USGCRP region)	Average change of 4.2% (B1) and 5.0% (A2); likely range is -0.8 to 9.3% for 2040-2059; very likely range is -5.9 to 14.4% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Great Plains (USGCRP region)	Average change of -2.9% (B1) and -5.4% (A2); likely range is -17.9 to 7.0% for 2040-2059; very likely range is -30.3 to 19.5% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Great Plains					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (spring: MAM)	Great Plains (USGCRP region)	Average change of 3.1% (B1) and 2.8% (A2); likely range is -2.8 to 8.4% for 2040-2059; very likely range is -8.5 to 14.1% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (fall: SON)	Great Plains (USGCRP region)	Average change of -1.1% (B1) and -1.1% (A2); likely range is -8.9 to 6.7% for 2040-2059; very likely range is -16.7 to 14.4% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Great Plains (USGCRP region)	Average change of 0.4% (B1) and -0.3% (A2); likely range is -6.3 to 5.8% for 2040-2059; very likely range is -12.4 to 11.9% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
2070-2100					
Temperature increase (mean annual)	Great Plains (USGCRP region)	Mean increase of 5.4 degrees F (B1) and 9.2 degrees F (A2); likely range is 3.9 to 11.2 degrees F for 2080-2098; very likely range is 2.5 to 13.2 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Great Plains					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (winter: DJF)	Great Plains (USGCRP region)	Mean increase of 5.3 degrees F (B1) and 8.3 degrees F (A2); likely range is 3.8 to 10.4 degrees F for 2080-2098; very likely range is 2.2 to 12.5 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (summer: JJA)	Great Plains (USGCRP region)	Mean increase of 5.8 degrees F (B1) and 10.6 degrees F (A2); likely range is 4.1 to 13.6 degrees F for 2080-2098; very likely range is 2.4 to 16.6 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Great Plains (USGCRP region)	Mean increase of 4.8 degrees F (B1) and 8.0 degrees F (A2); likely range is 3.1 to 10.3 degrees F for 2080-2098; very likely range is 1.3 to 12.7 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (fall: SON)	Great Plains (USGCRP region)	Mean increase of 5.5 degrees F (B1) and 9.6 degrees F (A2); likely range is 4.0 to 11.5 degrees F for 2080-2098; very likely range is 2.4 to 13.5 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Great Plains					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Average monthly maximum temperature	Great Plains	For 2070-2099: +4 to 4.5 degrees C (very southern Texas) +4.5 to 5 degrees C (Mid-Texas) +6.0-6.5 degrees C (Kansas, Oklahoma, Nebraska, ND, SD) with areas of +6.5 to 7.0 degrees C	Not provided; three climate models and one emission scenario (see below for one additional scenario)	Baseline period was 1971 to 2000, future period was 2070-2099; Results averaged across three GCMs, 0.5 degrees finer-resolution data generated by the VINCERA (Vulnerability and Impacts of North American Forests to Climate Change: Ecosystem Response and Adaptation). Scenario A2	Lenihan, J. et al. (2008)
Average monthly minimum temperature	Great Plains	For 2070-2099: +3.5-4 degrees C (very southern Texas) +4.0-4.5 degrees C (Mid-Texas) +4.5 to 5 degrees C (Upper Texas) +5.0 to 5.5 degrees C (Oklahoma, Kansas) +5.5 to 6.0 degrees C (ND, SD) with areas of 6.0 to 6.5 degrees C	Not provided; three climate models and one emission scenario (see below for one additional scenario)	Baseline period was 1971 to 2000, future period was 2070-2099; Results averaged across three GCMs, 0.5 degrees finer-resolution data generated by the VINCERA (Vulnerability and Impacts of North American Forests to Climate Change: Ecosystem Response and Adaptation). Scenario A2	Lenihan, J. et al. (2008)
Average monthly maximum temperature	Great Plains	For 2070-2099: +<3 degrees C (very southern Texas) +3-4 degrees C (Mid-Texas) +4.0 to 5 degrees C (Oklahoma) +5.0 to 5.5 degrees C (Oklahoma, Kansas) +4.5-5.0C (ND, SD)	Not provided; three climate models and one emission scenario	Baseline period was 1971 to 2000, future period was 2070-2099; Results averaged across three GCMs, 0.5 degrees finer-resolution data generated by the VINCERA (Vulnerability and Impacts of North American Forests to Climate Change: Ecosystem Response and Adaptation). Scenario B2	Lenihan, J. et al. (2008)
Average monthly minimum temperature	Great Plains	For 2070-2099: +<3 degrees C (very southern and Mid Texas) +3.5 to 4 degrees C (Oklahoma, Kansas) +3.5-4.5C (ND, SD)	Not provided; three climate models and one emission scenario	Baseline period was 1971 to 2000, future period was 2070-2099; Results averaged across three GCMs, 0.5 degrees finer-resolution data generated by the VINCERA (Vulnerability and Impacts of North American Forests to Climate Change: Ecosystem Response and Adaptation). Scenario B2	Lenihan, J. et al. (2008)

Great Plains

Climate Variable	U.S. Region	Projection	Certainty	Modeling Parameters	References
Precipitation (winter: DJF)	Great Plains (USGCRP region)	Average change of 5.1% (B1) and 8.3% (A2); likely range is -1.3 to 16.8% for 2080-2098; very likely range is -8.5 to 25.2% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Great Plains (USGCRP region)	Average change of -3.3% (B1) and -9.1% (A2); likely range is -29.3 to 11.1% for 2080-2098; very likely range is -49.4 to 31.3% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Great Plains (USGCRP region)	Average change of 4.3% (B1) and 2.7% (A2); likely range is -6.5 to 11.9% for 2080-2098; very likely range is -15.7 to 21.1% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (fall: SON)	Great Plains (USGCRP region)	Average change of -0.6% (B1) and 2.3% (A2); likely range is -16.7 to 12.0% for 2080-2098; very likely range is -31.0 to 26.3% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Great Plains					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (mean annual)	Great Plains (USGCRP region)	Average change of 0.9% (B1) and -1.2% (A2); likely range is -12.3 to 9.8% for 2080-2098; very likely range is -23.4 to 20.9% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Great Plains	For 2070-2099: +<10% (West Coast Texas) > -10% (Mid Central Texas) -20 to -10% (Oklahoma, Kansas) > -10% (ND, SD, Nebraska)	Not provided; three climate models and one emission scenario (see below for one additional scenarios)	Baseline period was 1971 to 2000, future period was 2070-2099. Results averaged across three GCMs, 0.5 degrees finer-resolution data generated by the VINCERA (Vulnerability and Impacts of North American Forests to Climate Change: Ecosystem Response and Adaptation). Scenario A2	Lenihan, J. et al. (2008)
Precipitation (mean annual)	Great Plains	For 2070-2099: +<10% (West Coast Texas) > -10% (Mid Central Texas) -20 to -10% (Small area in Oklahoma, most of Kansas and Oklahoma is >-10) > -10% (ND, SD, Nebraska) with western half of the states being <+10	Not provided; three climate models and one emission scenario	Baseline period was 1971 to 2000, future period was 2070-2099. Results averaged across three GCMs, 0.5 degrees finer-resolution data generated by the VINCERA (Vulnerability and Impacts of North American Forests to Climate Change: Ecosystem Response and Adaptation). Scenario B2	Lenihan, J. et al. (2008)

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
			2020-2040		
Temperature increase (mean annual)	Midwest (USGCRP region)	Mean increase of 2.7 degrees F (B1) and 2.6 degrees F (A2); likely range is 1.9 to 3.3 degrees F for 2010-2029; very likely range is 1.3 to 3.9 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Midwest (USGCRP region)	Mean increase of 3.0 degrees F (B1) and 2.6 degrees F (A2); likely range is 1.6 to 4.0 degrees F for 2010-2029; very likely range is 0.6 to 4.9 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (summer: JJA)	Midwest (USGCRP region)	Mean increase of 2.6 degrees F (B1) and 2.8 degrees F (A2); likely range is 1.9 to 3.8 degrees F for 2010-2029; very likely range is 1.0 to 4.7 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Midwest (USGCRP region)	Mean increase of 2.0 degrees F (B1) and 2.4 degrees F (A2); likely range is 1.2 to 3.3 degrees F for 2010-2029; very likely range is 0.4 to 4.1 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (fall: SON)	Midwest (USGCRP region)	Mean increase of 2.6 degrees F (B1) and 2.7 degrees F (A2); likely range is 2.0 to 3.4 degrees F for 2010-2029; very likely range is 1.3 to 4.1 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (mean annual)	Midwest (Chicago)	For 2010-2039: +1 (lower emission scenario) to 2 degrees C (higher emission scenario) increase	Not provided; Average of multiple climate models and 2 emission scenarios	Projected change in annual average temperature over Chicago relative to 1961-1990 average values, as simulated by 21 IPCC AR4 climate models for the SRES higher (A1F1) and lower (B1) emissions scenarios; Near term projection 2010-2039; Seasonal temps also provided in Table 2.1	Hellmann et al (2007); Chicago Climate Action Plan
Temperature (summer)	Missouri	For 2010-2039: increase by 3 degrees F (AlFi), increase by 1.5 degrees F (B1)	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 (lower emission scenario) and A1Fi (higher emission scenario)	Union of Concerned Scientists (2009a)
Temperature (summer)	Minnesota	For 2010-2039: increase by more than 3 degrees F (AlFi), increase by 1.5 degrees F (B1)	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 (lower emission scenario) and A1Fi (higher emission scenario)	Union of Concerned Scientists (2009b)

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature (summer)	Indiana	For 2010-2039: increase by more than 3 degrees F (AlFi), increase by 1.5 degrees F (B1)	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 (lower emission scenario) and A1Fi (higher emission scenario)	Union of Concerned Scientists (2009c)
Temperature (summer)	Wisconsin	For 2010-2039: increase by more than 3 degrees F (AlFi), increase by 1.5 degrees F (B1)	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 (lower emission scenario) and A1Fi (higher emission scenario)	Union of Concerned Scientists (2009d)
Temperature (summer)	Iowa	For 2010-2039: increase by more than 3 degrees F (AlFi), increase by 1.5 degrees F (B1)	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 (lower emission scenario) and A1Fi (higher emission scenario)	Union of Concerned Scientists (2009g)
Temperature (summer)	Ohio	For 2010-2039: increase by more than 3 degrees F (AlFi), increase by 1.5 degrees F (B1)	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 (lower emission scenario) and A1Fi (higher emission scenario)	Union of Concerned Scientists (2009i)

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (winter: DJF)	Midwest (USGCRP region)	Average change of 6.7% (B1) and 6.0% (A2); likely range is 1.9 to 11.5% for 2010-2029; very likely range is -2.9 to 16.3% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Midwest (USGCRP region)	Average change of -1.0% (B1) and -0.6% (A2); likely range is -7.2 to 6.0% for 2010-2029; very likely range is -13.9 to 12.7% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Midwest (USGCRP region)	Average change of 3.8% (B1) and 2.8% (A2); likely range is -1.4 to 8.0% for 2010-2029; very likely range is -5.6 to 12.2% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (fall: SON)	Midwest (USGCRP region)	Average change of 0.8% (B1) and 0.6% (A2); likely range is -5.3 to 6.6% for 2010-2029; very likely range is -11.2 to 12.5% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (mean annual)	Midwest (USGCRP region)	Average change of 2.2% (B1) and 2.0% (A2); likely range is -0.6 to 5.0% for 2010-2029; very likely range is -3.4 to 7.8% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Midwest (Chicago)	For 2010-2039: -2% (lower emission scenario) to +7% (higher emission scenario) change in precipitation	Average of multiple climate models run with 2 emission scenarios	Projected change in annual average temperature over Chicago relative to 1961-1990 average values, as simulated by 21 IPCC AR4 climate models for the A1Fi (higher emission scenario) and B1 (lower emission scenario); Near term projection 2010-2039; Seasonal precip also provided in Table 2.1	Hellmann et al (2007); Chicago Climate Action Plan
Precipitation (spring)	Missouri	For 2010-2039: Spring rainfall heavy projected to increase almost 15%	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009a)
Precipitaiton (extreme event)	St Louis, Missouri	For 2010-2039: more than 40% increase in the frequency of heavy rains (> 2 in of rain in one day)	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009a)

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (spring)	Minnesota	For 2010-2039: Spring rainfall projected to increase almost 15%	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009b)
Precipitation (heavy events)	Minneapolis-St. Paul, Minnesota	For 2010-2039: more than 66% increase in frequency of heavy rains (> 2 in of rain in one day)	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009b)
Precipitation (heavy events)	Indianapolis, Indiana	For 2010-2039: more than 35% increase in frequency of heavy rains (> 2 in of rain in one day)	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009c)
Precipitation (spring)	Wisconsin	For 2010-2039: Spring rainfall projected to increase almost 15%	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009d)

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (spring)	Illinois	For 2010-2039: Spring rainfall projected to increase almost 15%	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009e)
Precipitation (heavy rainfalls)	Chicago, Illinios	For 2010-2039: more than 20% increase in the frequency of heavy rains (> 2 in of rain in one day)	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009e)
Precipitation (heavy rainfalls)	Midwest cities Cincinnati and Indianapolis	For 2010-2039: 30% increase in frequency of heavy rains (> 2 in of rain in one day)	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009f)
Precipitation (heavy rainfalls)	Des Moines, Iowa	For 2010-2039: 20% increase in frequency of heavy rains (> 2 in of rain in one day)	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009g)

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (spring)	Ohio	For 2010-2039: Spring rainfall projected to increase almost 15%	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009i)
Precipitation (heavy rainfalls)	Cincinnati, Ohio	For 2010-2039: 30% increase in the frequency of heavy rains (> 2 in of rain in one day)	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009i)
2040-2070					
Temperature increase (mean annual)	Midwest (USGCRP region)	Mean increase of 4.0 degrees F (B1) and 5.0 degrees F (A2); likely range is 3.0 to 6.0 degrees F for 2040-2059; very likely range is 1.9 to 7.0 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Midwest (USGCRP region)	Mean increase of 4.1 degrees F (B1) and 5.3 degrees F (A2); likely range is 2.9 to 8.0 degrees F for 2040-2059; very likely range is 1.7 to 7.9 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (summer: JJA)	Midwest (USGCRP region)	Mean increase of 4.1 degrees F (B1) and 5.3 degrees F (A2); likely range is 2.8 to 6.8 degrees F for 2040-2059; very likely range is 1.5 to 8.3 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Midwest (USGCRP region)	Mean increase of 3.6 degrees F (B1) and 4.2 degrees F (A2); likely range is 2.2 to 5.6 degrees F for 2040-2059; very likely range is 0.8 to 7.0 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (fall: SON)	Midwest (USGCRP region)	Mean increase of 4.0 degrees F (B1) and 4.9 degrees F (A2); likely range is 2.9 to 5.8 degrees F for 2040-2059; very likely range is 1.7 to 6.7 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (mean annual)	Midwest (Chicago)	By 2040-2069: 1.5 (lower emission scenario) to 5 degrees C (higher emission scenario) increase	Average of multiple IPCC climate models with 2 emission scenarios	Projected change in annual average temperature over Chicago relative to 1961-1990 average values, as simulated by 21 IPCC AR4 climate models for the A1Fi (higher emission scenario) and B1 (lower emission scenario); Seasonal temps also provided in Table 2.1	Hellmann et al (2007): Chicago Climate Action Plan
Temperature increase (annual)	Missouri	For 2070-2099: increase of 14 degrees F (A1Fi) and 7 degrees F (B1)	Not provided; 3 climate models and 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 (lower emission scenario) and A1Fi (higher emission scenario)	Union of Concerned Scientists (2009a)

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (winter: DJF)	Midwest (USGCRP region)	Average change of 7.5% (B1) and 9.4% (A2); likely range is 0.5 to 14.8% for 2040-2059; very likely range is -6.4 to 21.4% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Midwest (USGCRP region)	Average change of -1.1% (B1) and -3.5% (A2); likely range is -14.9 to 7.8% for 2040-2059; very likely range is -26.2 to 19.2% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Midwest (USGCRP region)	Average change of 7.1% (B1) and 8.5% (A2); likely range is 3.2 to 13.3% for 2040-2059; very likely range is -1.0 to 18.1% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (fall: SON)	Midwest (USGCRP region)	Average change of 0.8% (B1) and 3.4% (A2); likely range is -6.3 to 10.7% for 2040-2059; very likely range is -13.5 to 18.0% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (mean annual)	Midwest (USGCRP region)	Average change of 3.3% (B1) and 4.2% (A2); likely range is -0.9 to 8.5% for 2040-2059; very likely range is -5.1 to 12.8% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Midwest	Mean annual averages of 2040-2059 compared to 1990-1999: +0.5% Central Wisconsin +10.2% East Central Indiana/West Central Ohio +8.7% Eastern Illinois -1.1% Eastern Wisconsin +14.2% Michigan Thumb +13.8% Northwestern Ohio, Southeastern Michigan +6.8% South Central Michigan/Northern Indiana +9.6% Southern Illinois +8.4% South Western Indiana -2.1% South Western Wisconsin +7.9% Western Illinois	Not provided; 1 climate model and 1 emission scenario	Baseline period was 1990 to 1999, future period was 2040-2059; HadCM3 with mid-range GHG scenario - IS95a; Each region shows a decrease in July precipitation and an increase in Oct; precipitation for 2040-2059 relative to baseline	O'Neal et al. (2005)
Precipitation (mean annual and event)	Upper Mississippi Basin (Mid-west)	By 2040-2050: 17% increase in both average precipitation and precipitation during extreme events (in mm per day) for the cold half of the year (October through March)	Not provided; 1 climate model with 1 emission scenario	Emissions scenario assumes a 1% increase in atmospheric greenhouse gas concentration after 1990; Results are relative to a control scenario where greenhouse gas concentration is fixed at its 1990 level; Uses regional model RegCM2 driven by HadCM2	Gutowski et al (2008)

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (mean annual)	Midwest (Chicago)	By 2040-2069: -2% (lower emission scenario) to +10% (higher emission scenario) change in precipitation in 2040-2069	Not provided; average of multiple models run with 2 emission scenarios	Projected change in annual average temperature over Chicago relative to 1961-1990 average values, as simulated by 21 IPCC AR4 climate models for the A1Fi (higher emission scenario) and B1 (lower emission scenario); Near term projection 2010-2039; Seasonal precip also provided in Table 2.1	Hellmann et al (2007); Chicago Climate Action Plan
2070-2100					
Temperature increase (mean annual)	Midwest (USGCRP region)	Mean increase of 5.6 degrees F (B1) and 9.6 degrees F (A2); likely range is 4.3 to 11.7 degrees F for 2080-2098; very likely range is 3.0 to 13.8 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Midwest (USGCRP region)	Mean increase of 6.0 degrees F (B1) and 9.4 degrees F (A2); likely range is 4.6 to 11.5 degrees F for 2080-2098; very likely range is 3.3 to 13.5 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (summer: JJA)	Midwest (USGCRP region)	Mean increase of 5.6 degrees F (B1) and 10.8 degrees F (A2); likely range is 4.2 to 14.2 degrees F for 2080-2098; very likely range is 2.7 to 17.5 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (spring: MAM)	Midwest (USGCRP region)	Mean increase of 5.1 degrees F (B1) and 8.4 degrees F (A2); likely range is 3.5 to 10.6 degrees F for 2080-2098; very likely range is 1.9 to 12.9 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (fall: SON)	Midwest (USGCRP region)	Mean increase of 5.5 degrees F (B1) and 9.6 degrees F (A2); likely range is 4.1 to 11.6 degrees F for 2080-2098; very likely range is 2.7 to 13.6 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (mean seasonal)	Midwest (Bounded by Mississippi river to the west and Ohio river to the south: IL, IN, IA, MI, MN, MS, OH, WI)	Mean seasonal increase in 2090-2099: +1 to 3 degrees C (A2/B2 PCM model) - winter +3 to 6 degrees C (A2/B2 PCM model) - summer +3 to 4 degrees C (A2/B2 HadCM3) - winter +5 to 8 degrees C (A2/B2 HadCM3) - summer +6 to 7 degrees C (A1F1 HadCM3) - winter +8 to 11 degrees C (A1F1 HadCM3) - summer +3 to 4 degrees C (B1 HadCm3) - winter +4 to 5 degrees C (B1 HadCM3) - summer	Not provided; 2 climate models with 4 emission scenarios	1961-1990 is the reference period, PCM and HadCm3 models are used; Future time period is 2090-2099; B1 and B2 emission scenarios (lower emission scenarios) and A2 and A1Fi emission scenarios (higher emission scenarios)	Wuebbles and Hayhoe (2004)

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (mean annual)	Midwest (Chicago)	For 2070-2099: range of 2 to 7 degrees C +3 to 4 degrees F (B1) +7 to 8 degrees F (A1F1)	Not provided; average of 3 climate models with 2 emission scenarios	Average of 3 climate models was used - GFDL CM2.1, HadCM3 and PCM; Reference period was 1961-1990; Seasonal temps also provided in Table 2.1; B1 emission scenario (lower emission scenario) and A1Fi (higher emission scenario)	Hellmann, J., B. Lesht and K. Nadelhoffer: Climate Change and Chicago (2007)
Temperature (summer)	Missouri	For 2070-2099: increase of 14 degrees F (A1Fi) and 7 degrees F (B1)	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 emission scenario (lower emission scenario) and A1Fi emission scenario (higher emission scenario)	Union of Concerned Scientists (2009a)
Temperature (summer)	Minnesota	For 2070-2099: increase of 12 degrees F (A1Fi) and 6 degrees F (B1)	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 emission scenario (lower emission scenario) and A1Fi emission scenario (higher emission scenario)	Union of Concerned Scientists (2009b)
Temperature (summer)	Indiana	For 2070-2099: increase by more than 13 degrees F (AlFi), increase by 6.5 degrees F (B1)	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 emission scenario (lower emission scenario) and A1Fi emission scenario (higher emission scenario)	Union of Concerned Scientists (2009c)

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature (summer)	Wisconsin	For 2070-2099: increase by more than 12 degrees F (AlFi), increase by 6 degrees F (B1)	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 emission scenario (lower emission scenario) and A1Fi emission scenario (higher emission scenario)	Union of Concerned Scientists (2009d)
Temperature (summer)	Iowa	For 2070-2099: increase by more than 14 degrees F (AlFi), increase by 7 degrees F (B1)	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 emission scenario (lower emission scenario) and A1Fi emission scenario (higher emission scenario)	Union of Concerned Scientists (2009g)
Temperature (summer)	Ohio	For 2070-2099: increase by more than 12 degrees F (AlFi), increase by 6 degrees F (B1)	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 emission scenario (lower emission scenario) and A1Fi emission scenario (higher emission scenario)	Union of Concerned Scientists (2009i)
Temperature anomalies (hot days)	Idaho (central)	To 2095: Area of US which is predicted to get a particularly large amount of hot day anomalies - up to 300% (ie 3x the hot event frequency observed in the past, where hot event is defined as 95th percentile)	Not provided; 1 model and 1 emission scenario	Regional model (RegCM3) using a baseline period of 1961 through 1985; A2 emission scenario	Diffenbaugh et al 2005, page 15775
Extreme heat event frequency	Midwest	For 2080-2100: 1-in-20-year extreme heat event (combination of high temperature and humidity) is projected to occur every 1 to 2 years	Not provided	A2 scenario; change in frequency of 1-in-20-year extreme heat events is relative to today	CMIP3-A (2008) as cited in USCCSP 2009

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Heat waves	Midwest (not defined)	For 2080-2099: +2 degrees C (3.6 degrees F) nighttime temperatures in worst heat waves	Not provided; 1 model and 1 emission scenario	NCAR's PCM model with a business as usual scenario (run with slightly different initial conditions); reference period was 1961-1990; 3 criteria for heatwave - maximum temp exceeding the 97.5 percentile for at least 3 days, average minimum temperature above the 97.5 percentile for at least 3 days and maximum temperature above the 81st percentile for the entire period	Ebi and Meehl (2007)
Heat waves	Midwest (Chicago, Cincinnati and St. Louis)	For 2080-2099: Increase in the average heatwave frequency of 24% (Chicago) - from 1.7 to 2.1 heatwaves per year; 50% (Cincinnati) - from 1.4 to 2.1 heatwaves per year; and 36% (St. Louis) from 1.4 to 1.9 heatwaves per year. Average across the 3 cities was 36% increase.	Not provided; 1 model and 1 emission scenario	NCAR's PCM model with a business as usual scenario (run with slightly different initial conditions); reference period was 1961-1990; 3 criteria for heatwave - maximum temp exceeding the 97.5 percentile for at least 3 days, average minimum temperature above the 97.5 percentile for at least 3 days and maximum temperature above the 81st percentile for the entire period	Ebi and Meehl (2007)
Heat waves	Midwest (Chicago, Cincinnati and St. Louis)	For 2080-2099: The average duration of heatwaves was projected to increase by 21% (Chicago) - from 7.3 to 8.8 days; by 22% (Cincinnati) - from 8.8 to 10.7 days; and by 38% for St. Louis - from 10.3 to 14.2 days. Average across the 3 cities was increase of 27%.	Not provided; 1 model and 1 emission scenario	NCAR's PCM model with a business as usual scenario (run with slightly different initial conditions); reference period was 1961-1990; 3 criteria for heatwave - maximum temp exceeding the 97.5 percentile for at least 3 days, average minimum temperature above the 97.5 percentile for at least 3 days and maximum temperature above the 81st percentile for the entire period	Ebi and Meehl (2007)

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Heat events	St Louis, Missouri	For 2070-2099: entire summer of days > 90 degrees F (A1Fi) which represents an increase of approximately 67 days, and this number is reduced to an increase of approximately 24 days under low emission scenario (B1). From 1961-1990, St Louis experiences approximately 38 days of temperature > 90 degrees F	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 emission scenario (lower emission scenario) and A1Fi emission scenario (higher emission scenario)	Union of Concerned Scientists (2009a)
Heat events	Minneapolis-St Paul, Minnesota	For 2070-2099: Total days per year over 90 degrees F is projected between 30 (B1) and almost 70 (A1Fi); Total days per year over 100 degrees F is projected between 7 (B1) and 28 (A1Fi); the historical baseline (1961-1990) is 12 days per year when temperatures are over 90 degrees F and less than 2 days per year when temperatures are over 100 degrees F	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 emission scenario (lower emission scenario) and A1Fi emission scenario (higher emission scenario)	Union of Concerned Scientists (2009b)

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Heat events	Indianapolis, Indiana	For 2070-2099: Total days per year over 90 degrees F is projected between 40 (B1) and over 80 (A1Fi); Total days per year over 100 degrees F is projected between 7 (B1) and 28 (A1Fi); the historical baseline (1961-1990) is 17 days per year when temperatures are over 90 degrees F and less than 1 day per year when temperatures are over 100 degrees F	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 emission scenario (lower emission scenario) and A1Fi emission scenario (higher emission scenario)	Union of Concerned Scientists (2009c)
Heat events	Milwaukee, Wisconsin	For 2070-2099: Total days per year over 90 degrees F is projected between about 23 (B1) and over 55 (A1Fi); Total days per year over 100 degrees F is projected between 5 (B1) and 22 (A1Fi); the historical baseline (1961-1990) is 8 days per year when temperatures are over 90 degrees F and less than 1 day per year when temperatures are over 100 degrees F	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 emission scenario (lower emission scenario) and A1Fi emission scenario (higher emission scenario)	Union of Concerned Scientists (2009d)

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Heat events	Chicago, Illinois	For 2070-2099: Total days per year over 90 degrees F is projected between 35 (B1) and over 70 (A1Fi); Total days per year over 100 degrees F is projected between 8 (B1) and 30 (A1Fi); the historical baseline (1961-1990) is 15 days per year when temperatures are over 90 degrees F and less than 2 days per year when temperatures are over 100 degrees F	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 emission scenario (lower emission scenario) and A1Fi emission scenario (higher emission scenario)	Union of Concerned Scientists (2009e)
Heat events	Detroit, Michigan	For 2070-2099: Total days per year over 90 degrees F is projected between 30 (B1) and about 65 (A1Fi); Total days per year over 100 degrees F is projected between 5 (B1) and 23 (A1Fi); the historical baseline (1961-1990) is 10 days per year when temperatures are over 90 degrees F and less than 1 day per year when temperatures are over 100 degrees F	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 emission scenario (lower emission scenario) and A1Fi emission scenario (higher emission scenario)	Union of Concerned Scientists (2009f)

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Heat events	Des Moines, Iowa	For 2070-2099: Total days per year over 90 degrees F is projected between about 47 (B1) and about 85 (A1Fi); Total days per year over 100 degrees F is projected between 9 (B1) and 33 (A1Fi); the historical baseline (1961-1990) is 22 days per year when temperatures are over 90 degrees F and less than 2 days per year when temperatures are over 100 degrees F	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 emission scenario (lower emission scenario) and A1Fi emission scenario (higher emission scenario)	Union of Concerned Scientists (2009g)
Heat events	Cincinnati, Ohio	For 2070-2099: Total days per year over 90 degrees F is projected between about 45 (B1) and about 85 (A1Fi); Total days per year over 100 degrees F is projected between 8 (B1) and 29 (A1Fi); the historical baseline (1961-1990) is about 18 days per year when temperatures are over 90 degrees F and less than 2 days per year when temperatures are over 100 degrees F	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 emission scenario (lower emission scenario) and A1Fi emission scenario (higher emission scenario)	Union of Concerned Scientists (2009i)

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Heat events	Cleveland, Ohio	For 2070-2099: Total days per year over 90 degrees F is projected between about 27 (B1) and about 61 (A1Fi); Total days per year over 100 degrees F is projected between 5 (B1) and 21 (A1Fi); the historical baseline (1961-1990) is about 8 days per year when temperatures are over 90 degrees F and less than 1 day per year when temperatures are over 100 degrees F	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B1 emission scenario (lower emission scenario) and A1Fi emission scenario (higher emission scenario)	Union of Concerned Scientists (2009i)
Precipitation (winter: DJF)	Midwest (USGCRP region)	Average change of 9.6% (B1) and 14.0% (A2); likely range is 3.3 to 22.2% for 2080-2098; very likely range is -2.9 to 30.4% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Midwest (USGCRP region)	Average change of -1.7% (B1) and -8.6% (A2); likely range is -31.0 to 13.8% for 2080-2098; very likely range is -53.4 to 36.2% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Midwest (USGCRP region)	Average change of 9.6% (B1) and 13.5% (A2); likely range is 1.5 to 24.9% for 2080-2098; very likely range is -9.3 to 36.4% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (fall: SON)	Midwest (USGCRP region)	Average change of 1.8% (B1) and 3.4% (A2); likely range is -9.9 to 16.7% for 2080-2098; very likely range is -23.1 to 30.0% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Midwest (USGCRP region)	Average change of 4.6% (B1) and 5.1% (A2); likely range is -5.5 to 15.7% for 2080-2098; very likely range is -16.2 to 26.4% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Midwest (Chicago)	For 2070-2099: -1% (lower emission scenario) to +19% (higher emission scenario) change in precipitation	Not provided; average of multiple models run with 2 emission scenarios	Projected change in annual average temperature over Chicago relative to 1961-1990 average values, as simulated by 21 IPCC AR4 climate models for the A1Fi (higher emission scenario) and B1 (lower emission scenario); Seasonal precip also provided in Table 2.1	Hellmann et al (2007); Chicago Climate Action Plan
Precipitation (seasonal)	Missouri	For 2079-2099: 20% increase in precipitation during winter and spring months and 14% increase in precipitation during autumn months; summer precipitation reduces by 20%	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009a)

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (heavy rainfalls)	St. Louis, Missouri	For 2079-2099: frequency of heavy rainfalls are projected to increase between 50% (B2) and 100% (A1Fi)	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B2 (lower emission scenario) and A1Fi (higher emission scenario)	Union of Concerned Scientists (2009a)
Precipitation (seasonal)	Minnesota	For 2070-2099: Winter and spring season up to 50% more precipitation, summers 15% less	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009b)
Precipitation (heavy rainfall)	Minneapolis-St. Paul, Minnesota	For 2079-2099: frequency of heavy rainfalls are projected to increase by almost 100%	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009b)
Precipitation (seasonal)	Indiana	For 2070-2099: Winter and spring precipitation to increase by almost 33%, summers to decrease by 9%	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009c)

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (heavy rainfall)	Milwaukee, Wisconsin	For 2079-2099: frequency of heavy rainfalls (> 2 in of rain in one day) are projected to increase by 100%	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009d)
Precipitation (seasonal)	Wisconsin	For 2070-2099: Winter and spring precipitation to increase by 33%, summers rain to decrease by 10%	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009d)
Precipitation (heavy rainfalls)	Chicago, Illinios	For 2070-2099: the frequency of heavy rains (> 2 in of rain in one day) to increase between for 35% (B2) to more than 50% (A1Fi)	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B2 (lower emission scenario) and A1Fi (higher emission scenario)	Union of Concerned Scientists (2009e)
Precipitaiton (seasonal rain)	Illinois	For 2070-2099: winter and spring precipitation to increase by 30% and summer precipitation to decrease by almost 15%	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009e)

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (heavy rainfalls)	Midwest cities Cincinnati and Indianapolis	For 2079-2099: heavy rainfalls are projected to increase in frequency between 50% (B2) and 100% (A1Fi)	Not provided; 3 climate models to capture climate sensitivity with 2 emission scenarios	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; B2 (lower emission scenario) and A1Fi (higher emission scenario)	Union of Concerned Scientists (2009f)
Precipitation (seasonal)	Michigan	For 2070-2099: more than 20% increase in winter and spring precipitation, 5 to 10% less precipitation in summer	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009f)
Precipitation (heavy rainfall)	Des Moines, Iowa	For 2070-2099: more than 50% increase in the frequency of heavy rains (> 2 in of rain in one day)	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009g)
Precipitation (season)	Iowa	For 2070-2099: more than a 33% increase in precipitation for winter and spring season, 20% less precipitation in summer season	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009g)

Midwest					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (heavy rainfall)	Cincinnati, Ohio	For 2070-2099: heavy rains (> 2 in of rain in one day) have a 50% increase in frequency	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009i)
Precipitation (season)	Ohio	For 2070-2099: winter and spring precipitation to increase more than a 33%, summer precipitation to decrease by 5%	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Statistical downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009i)
Water levels	Great Lakes	Water levels in Great Lakes projected to decline in summer and winter months with greatest decline for Lake Huron and Lake Michigan; Lake Erie projected to fall less than one ft (B2) and almost 1.5 ft (A1Fi)	Not provided; 3 climate models to capture climate sensitivity with 1 emission scenario	Downscaling of three climate models: GFDL, HadCM3, PCM; reference baseline period is 1961-1990; A1Fi emission scenario	Union of Concerned Scientists (2009i)

Southeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
			2020-2040		
Temperature increase (mean annual)	Southeast (USGRCP region)	Mean increase of 2.2 degrees F (B1) and 2.1 degrees F (A2); likely range is 1.7 to 2.7 degrees F for 2010-2029; very likely range is 1.2 to 3.2 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Southeast (USGRCP region)	Mean increase of 2.1 degrees F (B1) and 1.9 degrees F (A2); likely range is 1.1 to 2.8 degrees F for 2010-2029; very likely range is 0.3 to 3.6 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (summer: JJA)	Southeast (USGRCP region)	Mean increase of 2.3 degrees F (B1) and 2.4 degrees F (A2); likely range is 1.5 to 3.0 degrees F for 2010-2029; very likely range is 0.7 to 3.8 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Southeast (USGRCP region)	Mean increase of 2.0 degrees F (B1) and 1.8 degrees F (A2); likely range is 1.3 to 2.7 degrees F for 2010-2029; very likely range is 0.6 to 3.3 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Southeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (fall: SON)	Southeast (USGRCP region)	Mean increase of 2.3 degrees F (B1) and 2.3 degrees F (A2); likely range is 1.8 to 2.9 degrees F for 2010-2029; very likely range is 1.2 to 3.4 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Extreme heat days (summer: JJA)	Gulf Coast, Houston TX	For 2032: 50% probability of having 7 days at or above 100 degrees F, 25% probability of having 11 days at or above 100 degrees, 75% probability of having 4 days at or above 100 degrees. Current probability (in 2007) is roughly 20%.	Probability provided; 17 climate models and 1 emission scenario	A2 emissions scenario, 17 climate models of CMIP3 datasets for IPCC fourth assessment report	CCSP (2008) Gulf Coast study in Figure 3.15 on page 3F-14
Precipitation (winter: DJF)	Southeast (USGCRP region)	Average change of -0.7% (B1) and -0.4% (A2); likely range is -5.7 to 4.5% for 2010-2029; very likely range is -10.6 to 9.4% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Southeast (USGCRP region)	Average change of -0.2% (B1) and 0.2% (A2); likely range is -7.9 to 8.3% for 2010-2029; very likely range is -16.0 to 16.4% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Southeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (spring: MAM)	Southeast (USGCRP region)	Average change of -0.4% (B1) and -1.9% (A2); likely range is -6.9 to 3.8% for 2010-2029; very likely range is -11.9 to 8.1% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (fall: SON)	Southeast (USGCRP region)	Average change of 0.9% (B1) and 2.3% (A2); likely range is -4.4 to 7.0% for 2010-2029; very likely range is -9.7 to 11.8% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Southeast (USGCRP region)	Average change of -0.1% (B1) and 0.1% (A2); likely range is -4.3 to 4.3% for 2010-2029; very likely range is -8.5 to 8.5% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
2040-2070					
Temperature increase (mean annual)	Southeast (USGRCP region)	Mean increase of 3.2 degrees F (B1) and 4.0 degrees F (A2); likely range is 2.4 to 4.8 degrees F for 2040-2059; very likely range is 1.6 to 5.5 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Southeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (winter: DJF)	Southeast (USGCRP region)	Mean increase of 2.7 degrees F (B1) and 3.6 degrees F (A2); likely range is 1.6 to 4.5 degrees F for 2040-2059; very likely range is 0.5 to 5.4 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (summer: JJA)	Southeast (USGCRP region)	Mean increase of 3.5 degrees F (B1) and 4.5 degrees F (A2); likely range is 2.5 to 5.6 degrees F for 2040-2059; very likely range is 1.6 to 6.7 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Southeast (USGCRP region)	Mean increase of 3.1 degrees F (B1) and 3.8 degrees F (A2); likely range is 2.2 to 4.6 degrees F for 2040-2059; very likely range is 1.3 to 5.4 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (fall: SON)	Southeast (USGCRP region)	Mean increase of 3.4 degrees F (B1) and 4.3 degrees F (A2); likely range is 2.6 to 4.9 degrees F for 2040-2059; very likely range is 1.8 to 5.6 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Southeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (monthly mean)	Gulf Coast (region from Galveston, TX to Mobile Bay, AL)	For August, 2050: mean values: 2.5 degrees C (4.5 degrees F) for A1B, 1.8 degrees C (3.2 degrees F) for B1, 2.3 degrees C (4.1 degrees F) for A2; 5 to 95% range: 1.6 degrees C (2.9 degrees F) to 3.4 degrees C (6.1 degrees F) for A1B, 0.9 degrees C (1.6 degrees F) to 2.6 degrees C (4.7 degrees F) for B1, and 1.1 degrees C (2.0 degrees F) to 3.4 degrees C (6.1 degrees F) for A2	Very likely; up to 21 climate models and 3 emission scenarios	Scenarios A1B (moderate emission scenario), B1 (lower emission scenario), and A2 (higher emission scenario); up to 21 GCMs depending on scenario, reference period is 1980-1999	CCSP (2008): Gulf Coast Study Table 3-11 on page 3T-8
Extreme heat days (summer: JJA)	Gulf Coast, Houston TX	For 2057: 50% probability of having more than 20 days at or above 100 degrees F, 25% probability of having more than 20 days at or above 100 degrees, 75% probability of having 14 days at or above 100 degrees. Current probability (in 2007) is roughly 20%.	Probability provided; 17 climate models and 1 emission scenario	A2 emissions scenario, 17 climate models of CMIP3 datasets for IPCC fourth assessment report	CCSP (2008) Gulf Coast study Figure 3.15 on page 3F-14
Precipitation (winter: DJF)	Southeast (USGCRP region)	Average change of 1.4% (B1) and -2.0% (A2); likely range is -7.5 to 8.5% for 2040-2059; very likely range is -15.4 to 16.4% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Southeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (summer: JJA)	Southeast (USGCRP region)	Average change of 0.0% (B1) and -2.0% (A2); likely range is -14.2 to 10.2% for 2040-2059; very likely range is -26.4 to 22.5% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Southeast (USGCRP region)	Average change of 1.1% (B1) and 1.8% (A2); likely range is -4.8 to 7.9% for 2040-2059; very likely range is -10.7 to 13.9% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (fall: SON)	Southeast (USGCRP region)	Average change of -1.0% (B1) and -2.3% (A2); likely range is -9.1 to 4.6% for 2040-2059; very likely range is -16.0 to 11.5% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Southeast (USGCRP region)	Average change of 0.4% (B1) and -0.3% (A2); likely range is -6.8 to 6.2% for 2040-2059; very likely range is -13.3 to 12.6% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Southeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Storm events	Atlantic hurricane formation region	For 2040-2060: warming of 2 to 3 degrees F in sea surface temperature by mid-century for B1 scenario; warming of 2.5 to 3.5 degrees F in sea surface temperature for A2 scenario	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	B1 (lower emission scenario) and A2 (higher emission scenario); temperature increase is relative to 1900	CIMP3-A (2008) as cited in USGCRP 2009
Storm events	Gulf Coast (region from Galveston, TX to Mobile Bay, AL)	By late-century (2100), potential increase in category 1 or greater storms: 1 additional storm assuming a 5% increase in storm intensity; 2 additional storms assuming a 10% increase in storm intensity; 2 additional storms assuming a 15% increase in storm intensity; 2 additional storms assuming a 20% increase in storm intensity	Not provided; 1 model and 1 emission scenario	Increase in number of storms is relative to historical frequency; assumes an increase in hurricane intensity concomitant with increases in projected sea surface temperatures;	CCSP (2008) SAP 4.3 Gulf Coast Study: Figure 3.30 on p. 3F-29
Sea level rise	Gulf Coast (Louisiana Texas Chenier Plain)	By 2050: 94.8cm (high) 88.9 cm (mid) 83.0 cm (low)	Not provided, Uses 7 climate models with 1 emission scenario	SLRRP model assessed from combined output of 7 GCM models using A1F1 scenario; Relative to 1980-1999	CCSP (2008) Gulf Coast Study: Table 3-18 on page 3T-12
Sea level rise	Gulf Coast (Louisiana Deltaic Plain)	By 2050: 119.6 cm (high) 113.6 cm (mid) 107.5 cm (low)	Not provided, Uses 7 climate models with 1 emission scenario	SLRRP model assessed from combined output of 7 GCM models using A1F1 scenario; Relative to 1980-1999	CCSP (2008) Gulf Coast Study: Table 3-18 on page 3T-12

Southeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Sea level rise	Mississippi - Alabama Sound	by 2050: 59.8 cm (high) 53.9 cm (mid) 48.0 cm (low)	Not provided, Uses 7 climate models with 1 emission scenario	SLRRP model assessed from combined output of 7 GCM models using A1F1 scenario; Relative to 1980-1999	CCSP (2008) Gulf Coast Study: Table 3-18 on page 3T-12
2070-2100					
Temperature increase (mean annual)	Southeast (USGRCP region)	Mean increase of 4.5 degrees F (B1) and 7.8 degrees F (A2); likely range is 3.4 to 9.4 degrees F for 2080-2098; very likely range is 2.4 to 10.9 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Southeast (USGRCP region)	Mean increase of 4.0 degrees F (B1) and 6.3 degrees F (A2); likely range is 2.8 to 7.9 degrees F for 2080-2098; very likely range is 1.7 to 9.4 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Southeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (summer: JJA)	Southeast (USGRCP region)	Mean increase of 4.8 degrees F (B1) and 9.0 degrees F (A2); likely range is 3.5 to 11.2 degrees F for 2080-2098; very likely range is 2.3 to 13.5 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Southeast (USGRCP region)	Mean increase of 4.4 degrees F (B1) and 7.5 degrees F (A2); likely range is 3.2 to 9.1 degrees F for 2080-2098; very likely range is 2.0 to 10.7 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (fall: SON)	Southeast (USGRCP region)	Mean increase of 4.7 degrees F (B1) and 8.3 degrees F (A2); likely range is 3.5 to 9.8 degrees F for 2080-2098; very likely range is 2.4 to 11.3 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Southeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (monthly mean)	Gulf Coast (region from Galveston, TX to Mobile Bay, AL)	For August, 2050: mean value at 3.0 degrees C (5.4 degrees F) for A1B, 2.7 degrees C (4.9 degrees F) for B1, 4.7 degrees C (8.5 degrees F) for A2; the 5 to 95% percentile range is: 3.0 degrees C (5.4 degrees F) to 5.0 degrees C (9.0 degrees F) for A1B, 1.8 degrees C (3.2 degrees F) to 3.6 degrees C (6.5 degrees F) for B1, 3.3 degrees C(5.9 degrees F) to 6.0 degrees C (10.8 degrees F) for A2	Very likely range; 21 climate models for 3 emission scenarios	Scenarios A1B (moderate emission scenario), B1 (lower emission scenario), and A2 (higher emission scenario); up to 21 GCMs depending on scenario, reference period is 1980-1999	CCSP (2008): Gulf Coast Study Table 3-11 on page 3T-8
Extreme heat days (summer: JJA)	Gulf Coast, Houston TX	For 2099: approximately 100% probability of having 20 days at or above 100 degrees. Current probability (in 2007) of 20 days is near 0%.	Not provided; 17 climate models of 1 emission scenario	A2 emissions scenario, 17 climate models of CMIP3 datasets for IPCC fourth assessment report	CCSP (2008) Gulf Coast study in Figure 3.15 on page 3F-14
Temperature anomalies (hot days)	Appalachian Mountain region	To 2095: Area of United States which is predicted to get a particularly large amount of hot day anomalies - up to 280% (ie 2.8x the hot event frequency observed in the past, where hot event is defined as 95th percentile)	Not provided; 1 model with 1 emission scenario	Regional model (RegCM3) using a baseline period of 1961 through 1985; A2 emission scenario	Diffenbaugh et al (2005)
Extreme heat event	Southeast (USGCRP region)	For 2080-2100: 1-in-20-year extreme heat event (combination of high temperature and humidity) is projected to occur every 1 to 2 years	Not provided; multiple climate models for 1 emission scenario	A2 scenario; change in frequency of 1-in-20-year extreme heat events is relative to today using NCDC data;	CMIP3-A (2008) as cited in USGCRP 2009

Southeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (winter: DJF)	Southeast (USGCRP region)	Average change of 0.3% (B1) and -2.7% (A2); likely range is -15.2 to 10.3% for 2080-2098; very likely range is -27.7 to 22.3% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Southeast (USGCRP region)	Average change of 0.1% (B1) and -7.7% (A2); likely range is -28.9 to 13.5% for 2080-2098; very likely range is -50.0 to 34.7% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Southeast (USGCRP region)	Average change of 0.8% (B1) and -7.0% (A2); likely range is -19.7 to 7.1% for 2080-2098; very likely range is -32.4 to 18.4% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (fall: SON)	Southeast (USGCRP region)	Average change of 2.3% (B1) and 3.2% (A2); likely range is -9.3 to 15.7% for 2080-2098; very likely range is -10.2 to 28.2% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Southeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (mean annual)	Southeast (USGCRP region)	Average change of 0.9% (B1) and -3.5% (A2); likely range is -15.0 to 8.0% for 2080-2098; very likely range is -26.5 to 19.5% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual or seasonal)	Mid-Atlantic coast	For 2071 to 2095: Anomalies of mean annual precipitation were positive, with peak differences of up to 1.75 mm/day (up to 40%) over the mid-Atlantic coast (Meaning future years up to 40% rainier than past). (up to 2095)	Not provided; 1 model with 1 emission scenario	Regional model (RegCM3) using a baseline period of 1961 through 1985; A2 emission scenario	Diffenbaugh et al (2005)
Precipitation (mean annual or seasonal)	Southeast	For 2080-2099: 10 to 20% decrease in the summer; 10% increase in the fall	Certainty is highest that precipitation will increase in the Fall (2 out of 3 climate models agree); Other precipitation effects are not as certain	A2 scenario; Relative to 1961-1979; simulated by 15 climate models	CMIP3-A (2008) as cited in USGCRP 2009

Southeast					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Storm events	Gulf Coast (region from Galveston, TX to Mobile Bay, AL)	By late-century (2100), potential increase in category 1 or greater storms: 1 storm assuming a 5% increase in storm intensity; 2 storms assuming a 10% increase in storm intensity; 3 storms assuming a 15% increase in storm intensity; 4 storms assuming a 20% increase in storm intensity	Not Provided	Increase in number of storms is relative to historical frequency; assumes an increase in hurricane intensity concomitant with increases in projected sea surface temperatures;	CCSP (2008) SAP 4.7 Gulf Coast Study: Figure 3.30 on p. 3F-29
Storm events	Atlantic hurricane formation region	For 2080-2100: warming of 3 to 4 degrees F in sea surface temperature for B1; warming of 5 to 7 degrees F in sea surface temperature for A2	Likely; multiple climate models and 2 emission scenarios	B1 (lower emission scenario) and A2 (higher emission scenario); temperature increase is relative to 1900	CIMP3-A (2008) as cited in USGCRP 2009
Sea level rise	Gulf Coast (Louisiana Texas Chenier Plain)	By 2050: 161.3 cm (high), 146.0 cm (mid), 130.7 cm (low)	Not provided; 7 climate models using 1 emission scenario	SLRRP model assessed from combined output of 7 GCM models using A1F1 scenario; Relative to 1980-1999	CCSP (2008) Gulf Coast Study: Table 3-18 on page 3T-12
Sea level rise	Gulf Coast (Louisiana Deltaic Plain)	By 2100: 199.6 cm (high) 185.3 cm (mid) 171.2 cm (low)	Not provided; 7 climate models using 1 emission scenario	SLRRP model assessed from combined output of 7 GCM models using A1F1 scenario; Relative to 1980-1999	CCSP (2008) Gulf Coast Study: Table 3-18 on page 3T-1
Sea level rise	Mississippi - Alabama Sound	By 2100: 114.5 cm (high) 99.2 cm (mid) 83.9 cm (low)	Not provided; 7 climate models using 1 emission scenario	SLRRP model assessed from combined output of 7 GCM models using A1F1 scenario; Relative to 1980-1999	CCSP (2008) Gulf Coast Study: Table 3-18 on page 3T-12

Hawaii					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
			2020-2040		
Temperature increase (mean annual)	Hawaii	Mean increase of 1.8 degrees F (B1) and 1.7 degrees F (A2); likely range is 1.0 to 2.5 degrees F for 2010-2029; very likely range is 0.3 to 3.2 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Hawaii	Mean increase of 1.7 degrees F (B1) and 1.7 degrees F (A2); likely range is 1.0 to 2.4 degrees F for 2010-2029; very likely range is 0.3 to 3.0 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (summer: JAG)	Hawaii	Mean increase of 1.8 degrees F (B1) and 1.8 degrees F (A2); likely range is 1.0 to 2.6 degrees F for 2010-2029; very likely range is 0.1 to 3.4 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Hawaii	Mean increase of 1.8 degrees F (B1) and 1.6 degrees F (A2); likely range is 0.9 to 2.6 degrees F for 2010-2029; very likely range is 0.1 to 3.4 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Hawaii					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (fall: SON)	Hawaii	Mean increase of 1.8 degrees F (B1) and 1.8 degrees F (A2); likely range is 1.0 to 2.6 degrees F for 2010-2029; very likely range is 0.3 to 3.3 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (winter: DJF)	Hawaii	Average change of -2.3% (B1) and -2.1% (A2); likely range is -14.5 to 9.9% for 2010-2029; very likely range is -26.8 to 22.2% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Hawaii	Average change of -3.2% (B1) and -5.0% (A2); likely range is -17.6 to 7.7% for 2010-2029; very likely range is -30.3 to 20.4% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Hawaii	Average change of 0.4% (B1) and 0.8% (A2); likely range is -9.5 to 11.0% for 2010-2029; very likely range is -19.6 to 21.2% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Hawaii					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (fall: SON)	Hawaii	Average change of 1.5% (B1) and -1.1% (A2); likely range is -11.1 to 11.1% for 2010-2029; very likely range is -21.2 to 20.6% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Hawaii	Average change of -0.8% (B1) and -1.5% (A2); likely range is -9.7 to 6.7% for 2010-2029; very likely range is -17.9 to 14.9% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
2040-2070					
Temperature increase (mean annual)	Hawaii	Mean increase of 2.7 degrees F (B1) and 3.3 degrees F (A2); likely range is 2.0 to 4.0 degrees F for 2040-2059; very likely range is 1.2 to 4.6 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Hawaii	Mean increase of 2.7 degrees F (B1) and 3.2 degrees F (A2); likely range is 1.9 to 3.9 degrees F for 2040-2059; very likely range is 1.1 to 4.6 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Hawaii					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (summer: JJA)	Hawaii	Mean increase of 2.7 degrees F (B1) and 3.4 degrees F (A2); likely range is 1.9 to 4.0 degrees F for 2040-2059; very likely range is 1.1 to 4.7 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Hawaii	Mean increase of 2.7 degrees F (B1) and 3.2 degrees F (A2); likely range is 1.9 to 3.7 degrees F for 2040-2059; very likely range is 1.1 to 4.3 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (fall: SON)	Hawaii	Mean increase of 2.8 degrees F (B1) and 3.5 degrees F (A2); likely range is 2.0 to 4.4 degrees F for 2040-2059; very likely range is 1.2 to 5.2 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (winter: DJF)	Hawaii	Average change of -2.5% (B1) and -1.7% (A2); likely range is -21.0 to 17.6% for 2040-2059; very likely range is -40.2 to 36.8% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Hawaii					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (summer: JJA)	Hawaii	Average change of -3.0% (B1) and -0.9% (A2); likely range is -22.8 to 21.1 % for 2040-2059; very likely range is -44.8 to 43.1% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Hawaii	Average change of -1.6% (B1) and -2.3% (A2); likely range is -12.6 to 9.4 % for 2040-2059; very likely range is -23.5 to 20.4% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (fall: SON)	Hawaii	Average change of 2.9% (B1) and 5.9% (A2); likely range is -14.9 to 26.6 % for 2040-2059; very likely range is -35.7 to 47.4% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Hawaii	Average change of -0.6% (B1) and 0.7% (A2); likely range is -11.3 to 12.6% for 2040-2059; very likely range is -23.2 to 24.5% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Hawaii					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
		2070-2100			
Temperature increase (mean annual)	Northeast (USGCRP region)	Mean increase of 3.9 degrees F (B1) and 6.7 degrees F (A2); likely range is 2.8 to 7.8 degrees F for 2080-2098; very likely range is 1.8 to 8.9 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Hawaii	Mean increase of 3.8 degrees F (B1) and 6.4 degrees F (A2); likely range is 2.7 to 7.5 degrees F for 2080-2098; very likely range is 1.6 to 8.5 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (summer: JJA)	Hawaii	Mean increase of 3.9 degrees F (B1) and 6.7 degrees F (A2); likely range is 2.8 to 7.9 degrees F for 2080-2098; very likely range is 1.7 to 9.2 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Hawaii	Mean increase of 3.8 degrees F (B1) and 6.3 degrees F (A2); likely range is 2.8 to 7.2 degrees F for 2080-2098; very likely range is 1.8 to 8.1 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Hawaii

Climate Variable	U.S. Region	Projection	Certainty	Modeling Parameters	References
Temperature increase (fall: SON)	Hawaii	Mean increase of 4.0 degrees F (B1) and 7.2 degrees F (A2); likely range is 2.8 to 8.7 degrees F for 2080-2098; very likely range is 1.6 to 10.3 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (winter: DJF)	Hawaii	Average change of -3.9% (B1) and -0.8% (A2); likely range is -25.3 to 22.4 % for 2080-2098; very likely range is -47.2 to 45.6% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Hawaii	Average change of -1.4% (B1) and 4.6% (A2); likely range is -41.8 to 51.1 % for 2080-2098; very likely range is -88.3 to 97.6% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Hawaii	Average change of -4.9% (B1) and 6.3% (A2); likely range is -20.1 to 8.7 % for 2080-2098; very likely range is -34.0 to 22.4% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Hawaii					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (fall: SON)	Hawaii	Average change of 0.9% (B1) and 18.5% (A2); likely range is -38.3 to 75.4 % for 2080-2098; very likely range is -95.2 to 132.2% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Hawaii	Average change of -1.9% (B1) and 4.0% (A2); likely range is -16.6 to 24.7 % for 2080-2098; very likely range is -37.2 to 45.3% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Caribbean					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
			2020-2040		
Temperature increase (mean annual)	Caribbean	Mean increase of 1.6 degrees F (B1) and 1.7 degrees F (A2); likely range is 1.2 to 2.1 degrees F for 2010-2029; very likely range is 0.8 to 2.5 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Caribbean	Mean increase of 1.6 degrees F (B1) and 1.6 degrees F (A2); likely range is 1.1 to 2.0 degrees F for 2010-2029; very likely range is 0.8 to 2.5 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (summer: JJA)	Caribbean	Mean increase of 1.7 degrees F (B1) and 1.8 degrees F (A2); likely range is 1.2 to 2.1 degrees F for 2010-2029; very likely range is 0.8 to 2.6 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Caribbean	Mean increase of 1.5 degrees F (B1) and 1.6 degrees F (A2); likely range is 1.1 to 2.0 degrees F for 2010-2029; very likely range is 0.6 to 2.5 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Caribbean

Climate Variable	U.S. Region	Projection	Certainty	Modeling Parameters	References
Temperature increase (fall: SON)	Caribbean	Mean increase of 1.7 degrees F (B1) and 1.8 degrees F (A2); likely range is 1.3 to 2.1 degrees F for 2010-2029; very likely range is 0.9 to 2.5 degrees F for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (winter: DJF)	Caribbean	Average change of -0.8% (B1) and -2.5% (A2); likely range is -8.7 to 5.2% for 2010-2029; very likely range is -15.0 to 11.3% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Caribbean	Average change of -6.9% (B1) and -9.6% (A2); likely range is -16.2 to 0.6% for 2010-2029; very likely range is -22.8 to 8.2% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Caribbean	Average change of -6.7% (B1) and -6.2% (A2); likely range is -15.3 to 1.9% for 2010-2029; very likely range is -23.9 to 10.5% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Caribbean					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (fall: SON)	Caribbean	Average change of -0.7% (B1) and -2.0% (A2); likely range is -9.1 to 5.6% for 2010-2029; very likely range is -16.2 to 12.2% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Caribbean	Average change of -3.2% (B1) and -4.6% (A2); likely range is -10.5 to 1.7% for 2010-2029; very likely range is -16.5 to 7.2% for 2010-2029	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
2040-2070					
Temperature increase (mean annual)	Caribbean	Mean increase of 2.5 degrees F (B1) and 3.1 degrees F (A2); likely range is 2.0 to 3.5 degrees F for 2040-2059; very likely range is 1.4 to 3.9 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Caribbean	Mean increase of 2.4 degrees F (B1) and 3.0 degrees F (A2); likely range is 1.9 to 3.5 degrees F for 2040-2059; very likely range is 1.3 to 3.9 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Caribbean					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature increase (summer: JJA)	Caribbean	Mean increase of 2.6 degrees F (B1) and 3.2 degrees F (A2); likely range is 2.1 to 3.6 degrees F for 2040-2059; very likely range is 1.5 to 4.0 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Caribbean	Mean increase of 2.5 degrees F (B1) and 3.0 degrees F (A2); likely range is 1.9 to 3.4 degrees F for 2040-2059; very likely range is 1.3 to 3.7 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (fall: SON)	Caribbean	Mean increase of 2.7 degrees F (B1) and 3.3 degrees F (A2); likely range is 2.1 to 3.7 degrees F for 2040-2059; very likely range is 1.5 to 4.1 degrees F for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (winter: DJF)	Caribbean	Average change of -2.7% (B1) and -5.3% (A2); likely range is -13.8 to 4.5% for 2040-2059; very likely range is -22.2 to 11.6% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Caribbean					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (summer: JJA)	Caribbean	Average change of -11.9% (B1) and -18.3% (A2); likely range is -31.3 to -0.5% for 2040-2059; very likely range is -44.3 to 10.9% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Caribbean	Average change of -8.3% (B1) and -16.1% (A2); likely range is -24.7 to 0.3% for 2040-2059; very likely range is -33.3 to 9.0% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (fall: SON)	Caribbean	Average change of -2.9% (B1) and -3.6% (A2); likely range is -14.5 to 7.3% for 2040-2059; very likely range is -25.5 to 18.2% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Caribbean	Average change of -6.0% (B1) and -9.8% (A2); likely range is -18.9 to 1.4% for 2040-2059; very likely range is -27.9 to 8.8% for 2040-2059	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Caribbean					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
2070-2100					
Temperature increase (mean annual)	Caribbean	Mean increase of 3.6 degrees F (B1) and 6.1 degrees F (A2); likely range is 2.7 to 6.8 degrees F for 2080-2098; very likely range is 1.9 to 7.5 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (winter: DJF)	Caribbean	Mean increase of 3.5 degrees F (B1) and 5.8 degrees F (A2); likely range is 2.6 to 6.6 degrees F for 2080-2098; very likely range is 1.7 to 7.5 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (summer: JJA)	Caribbean	Mean increase of 3.7 degrees F (B1) and 6.2 degrees F (A2); likely range is 2.8 to 6.9 degrees F for 2080-2098; very likely range is 1.9 to 7.6 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Temperature increase (spring: MAM)	Caribbean	Mean increase of 3.5 degrees F (B1) and 5.8 degrees F (A2); likely range is 2.7 to 6.5 degrees F for 2080-2098; very likely range is 1.8 to 7.2 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Caribbean					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Temperature Increase (fall: SON)	Caribbean	Mean increase of 3.7 degrees F (B1) and 6.4 degrees F (A2); likely range is 2.8 to 7.1 degrees F for 2080-2098; very likely range is 1.9 to 7.9 degrees F for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (winter: DJF)	Caribbean	Average change of -1.9% (B1) and -8.0% (A2); likely range is -21.6 to 6.1% for 2080-2098; very likely range is -35.3 to 19.2% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (summer: JJA)	Caribbean	Average change of -14.0% (B1) and -36.0% (A2); likely range is -51.8 to 0.1% for 2080-2098; very likely range is -67.7 to 14.3% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (spring: MAM)	Caribbean	Average change of -8.7% (B1) and -27.7% (A2); likely range is -39.4 to 2.0% for 2080-2098; very likely range is -51.1 to 12.7% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

Caribbean					
Climate Variable	**U.S. Region**	**Projection**	**Certainty**	**Modeling Parameters**	**References**
Precipitation (fall: SON)	Caribbean	Average change of -3.9% (B1) and -9.0% (A2); likely range is -27.9 to 9.9% for 2080-2098; very likely range is -46.7 to 28.7% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009
Precipitation (mean annual)	Caribbean	Average change of -7.0% (B1) and -18.8% (A2); likely range is -33.3 to 2.7% for 2080-2098; very likely range is -47.8 to 12.4% for 2080-2098	Likely; Very likely; 15 to 19 climate models bracketed by 2 emission scenarios	Reference period is 1961-1979; B1 emission scenario (lower emission scenario) and A2 emission scenario (higher emission scenario); 19 GCMs for B1 Scenario and 15 GCMs for A2 scenarios	USGCRP 2009

2 Terminology

2.1 Certainty

The typology matrix includes a column for "certainty". This column provides information regarding the level of certainty associated with the projections cited in each study. 1) For USGCRP (2009) data, the "likely" and "very likely" terms represent one and two standard deviations from the mean, respectively. This follows the definition provided by the IPCC (2007) where the term "likely" represents a greater than a 66% probability and "very likely" represents a greater than 95% probability. 2) Other studies referenced may also use "likely" and "very likely" to describe the certainty, but the authors of the typology matrix generally did not attempt to verify that each study uses the IPCC definition for these terms. 3) For those studies that do not quantify certainty a qualitative description of study parameters that influence the level of certainty that can be assumed is provided. Such parameters include information on the number of climate models, the climate sensitivity of those climate models if known, and the choice of emission scenarios.

2.2 Emissions

The IPCC developed a number of emission scenarios described in the IPCC Special Report on Emissions Scenarios (SRES) (2000) associated with plausible storylines representing varying degrees of projected economic, regional, and environmental change as well as allowing for global integration. These studies tend to draw from the following IPCC SRES:

• A1Fi assumes very rapid per capita economic growth, global population peaking in 2050, rapid introduction of new and more efficient technology but still fossil-intensive;

• A1B assumes very rapid per capita economic growth, global population peak in 2050, rapid introduction of new and more efficient technology being evenly distributed between fossil and non-fossil technology;

• B1 assumes rapid changes in economy though slower growth than the A1 scenarios, same global population pattern as in A1, with new technology becoming clean and resource-efficient;

• B2 assumes intermediate levels of economic development, continously increasing population (slower rate than A2), less rapid technological change compared to A1 and B1;

• A2 assumes slowest economic development of all the scenarios in terms of per-capita growth, has the highest global population allowing for a continuous increase in population, with the slowest and most fragmented technological development.

• There are also studies that provide projections based on the IPCC "Business as Usual" Scenario (termed IS92a Scenario). This scenario increases the effective carbon dioxide concentration by 1% per year after 1990. The effective carbon dioxide concentration of this scenario is somewhat higher than the effective carbon dioxide concentration of the A2 emission scenario (CCCma 2007).

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