Planning for Climate Change

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Municipal Planning Assistance Program
Department of Agriculture, Conservation and Forestry

Maine Emergency Preparedness Conference
April 21, 2015

What’s changing about Maine’s climate?

CHANGING TEMPERATURES IN MAINE

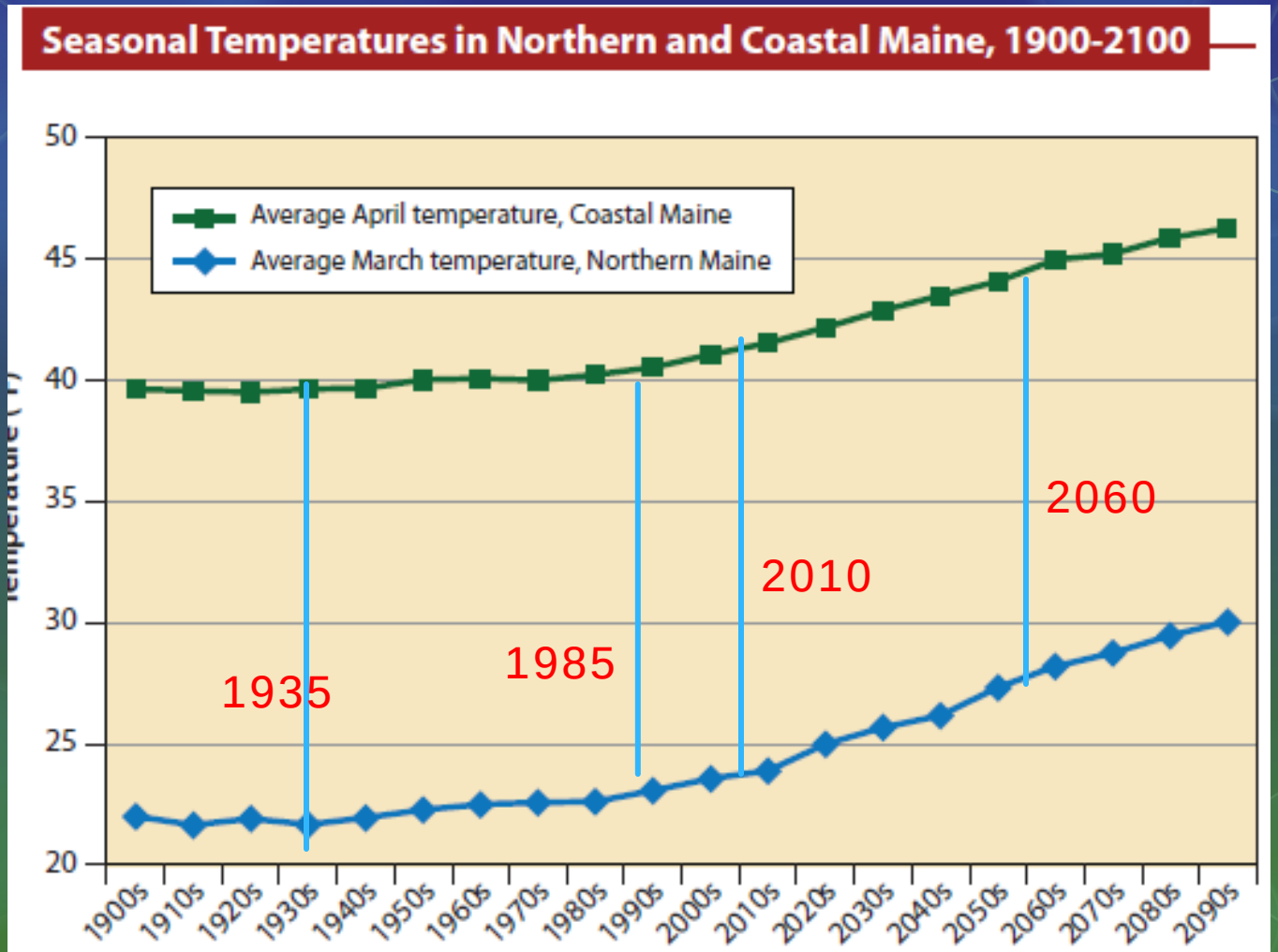


Figure 22 Average temperatures for March (Northern climate division) and April (Coastal division) for each year calculated across the 42 ensemble climatic states and averaged acros s the decades shown (see Appendix for details).

Maine's Climate Future 2009

Maine's Average Annual Temperature

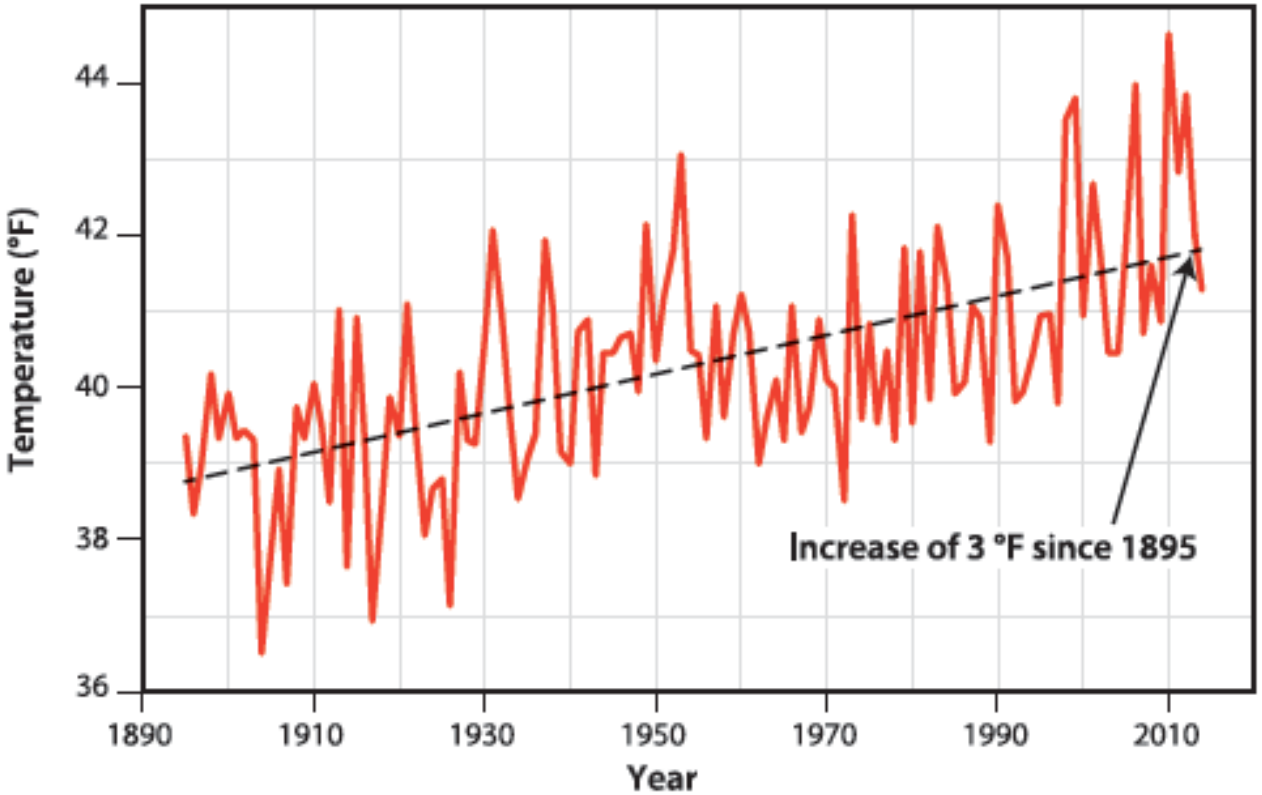


Figure 1. Mean annual temperature, 1895–2014, averaged across Maine from gridded monthly station records from the U.S. Climate Divisional Dataset (*ncdc.noaa.gov/monitoring-references/maps/us-climate-divisions.php*). A simplified linear trend (black line) indicates that temperature increased 3 °F over the record period.

Maine's Climate Future 2015

Present and Future Temperature

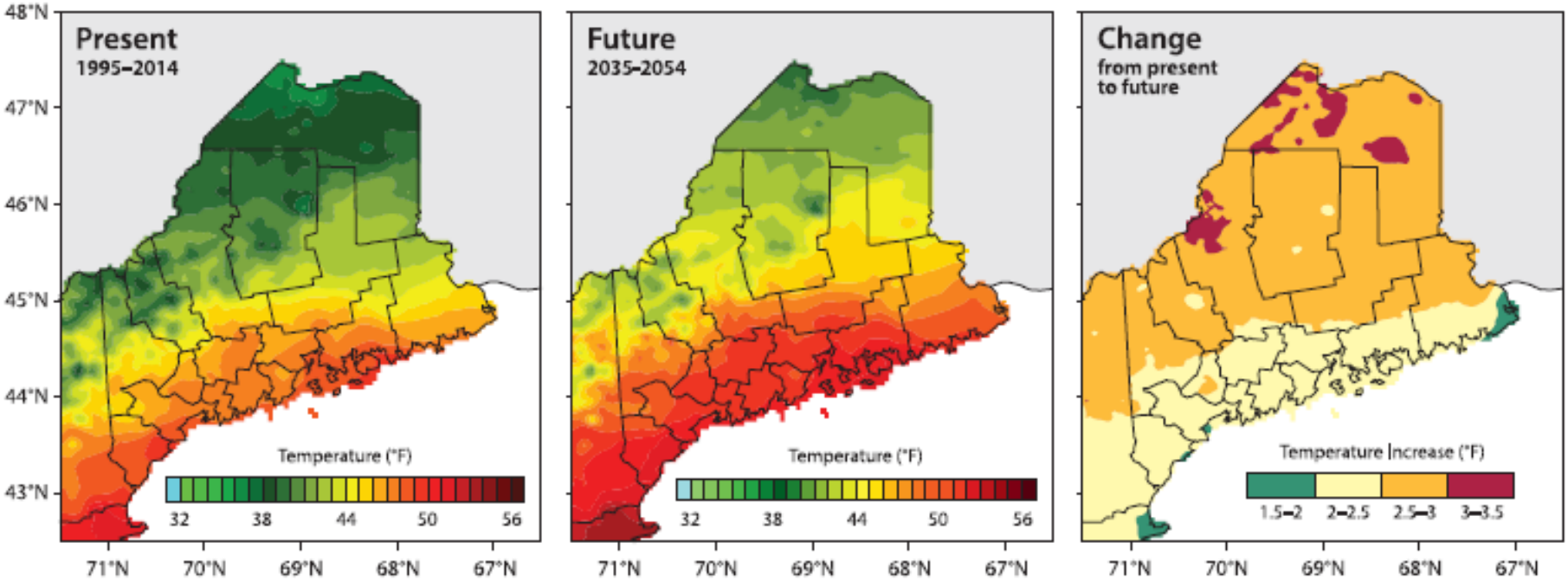


Figure 2. Maps showing mean annual temperature for 1995–2014 (left), 2035–2054 (center), and the predicted change or difference between the two time periods (right). The predicted rise in temperature by 2050 ranges 2.0–3.0 °F from the coast inland to the Canadian border. Maps derived from an ensemble simulation of the IPCC A2 emissions scenario.[1]

Maine's Climate Future 2015

Projected Increases in the Number of Days over 90°F

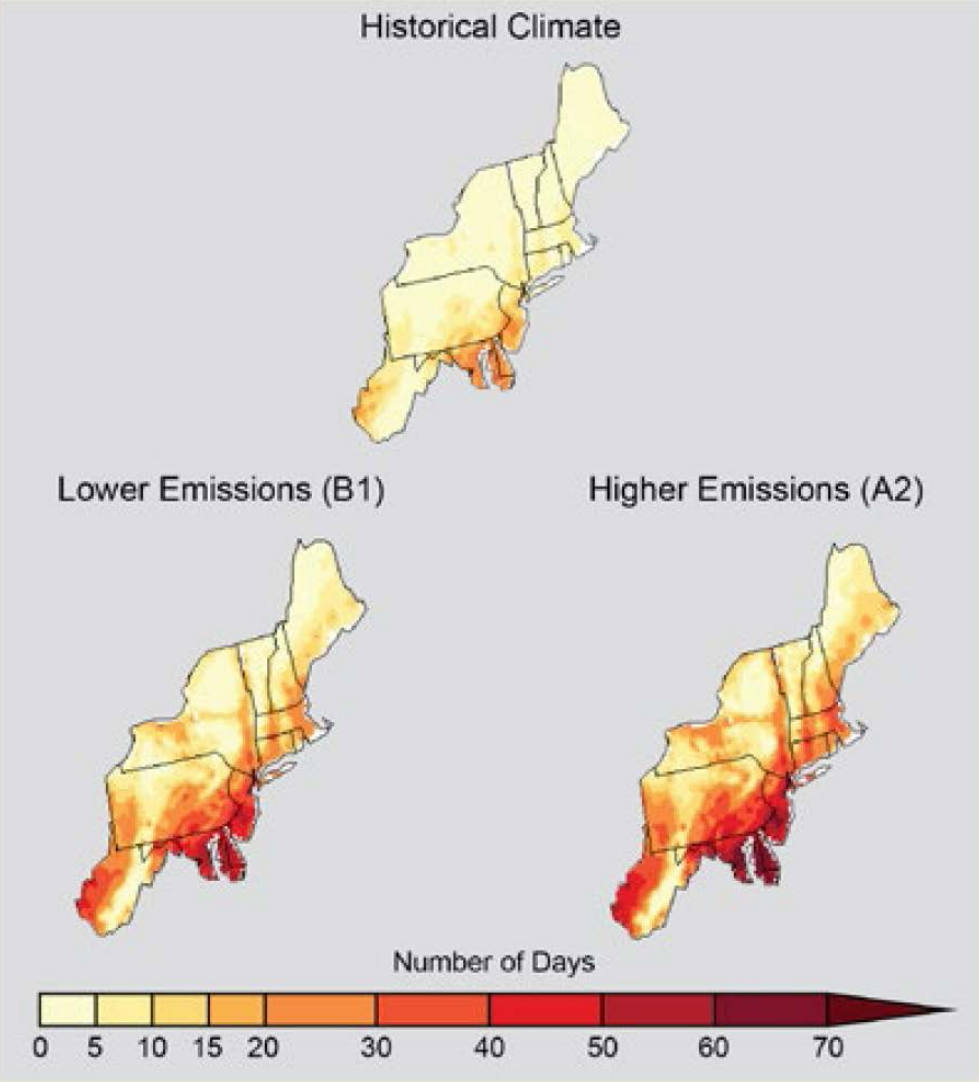
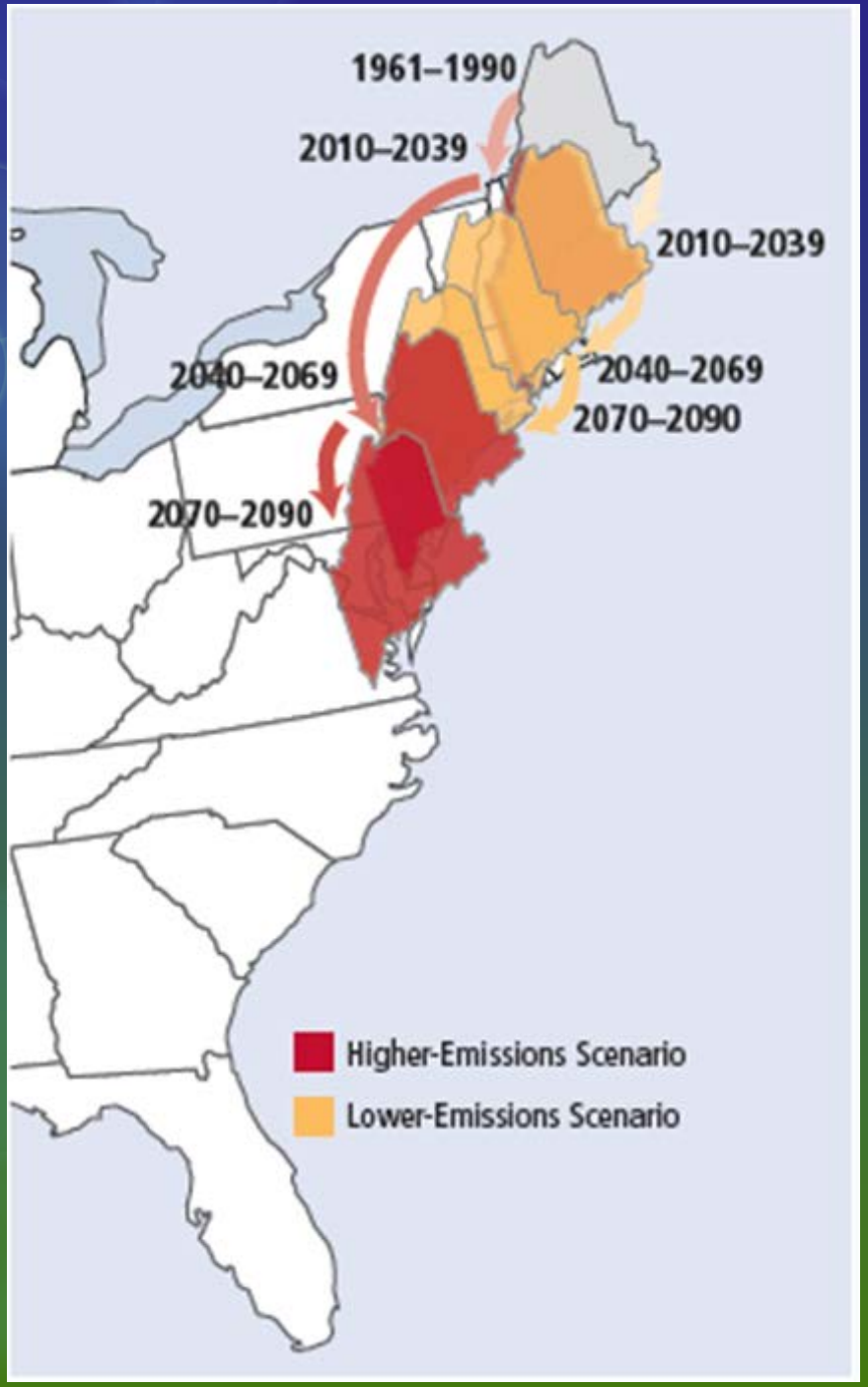
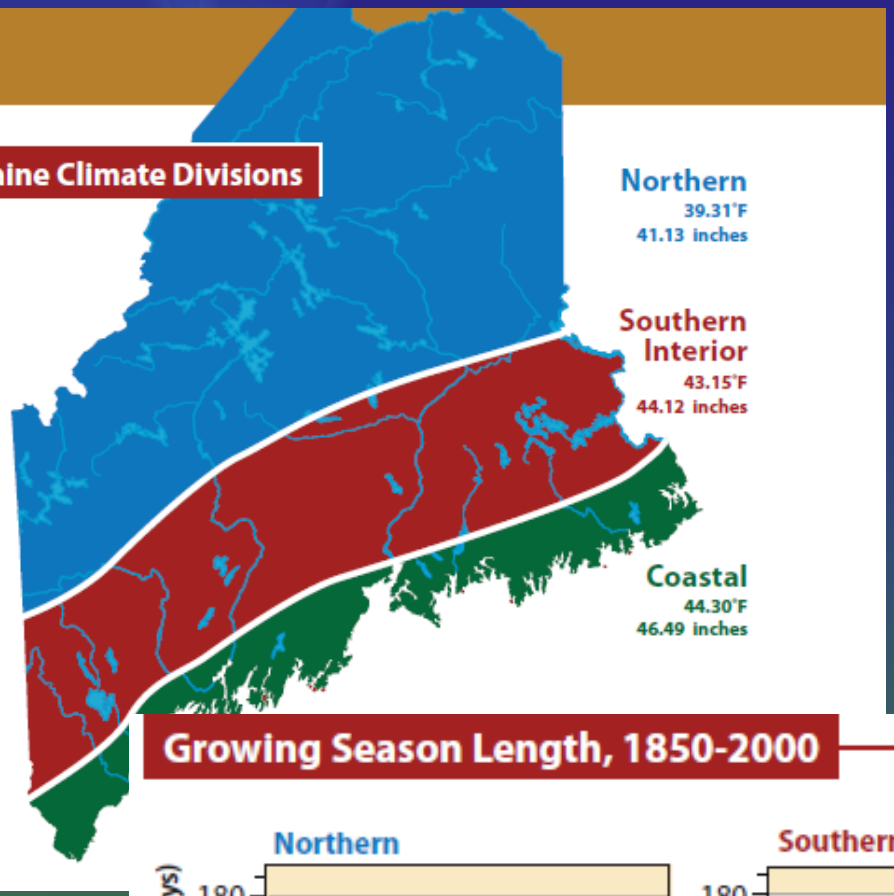


Figure 16.2. Projected increase in the number of days per year with a maximum temperature greater than 90°F averaged between 2041 and 2070, compared to 1971-2000, assuming continued increases in global emissions (A2) and substantial reductions in future emissions (B1). (Figure source: NOAA NCDC / CICS-NC).



Cameron Wake
University of New Hampshire



Growing Season Length, 1850-2000

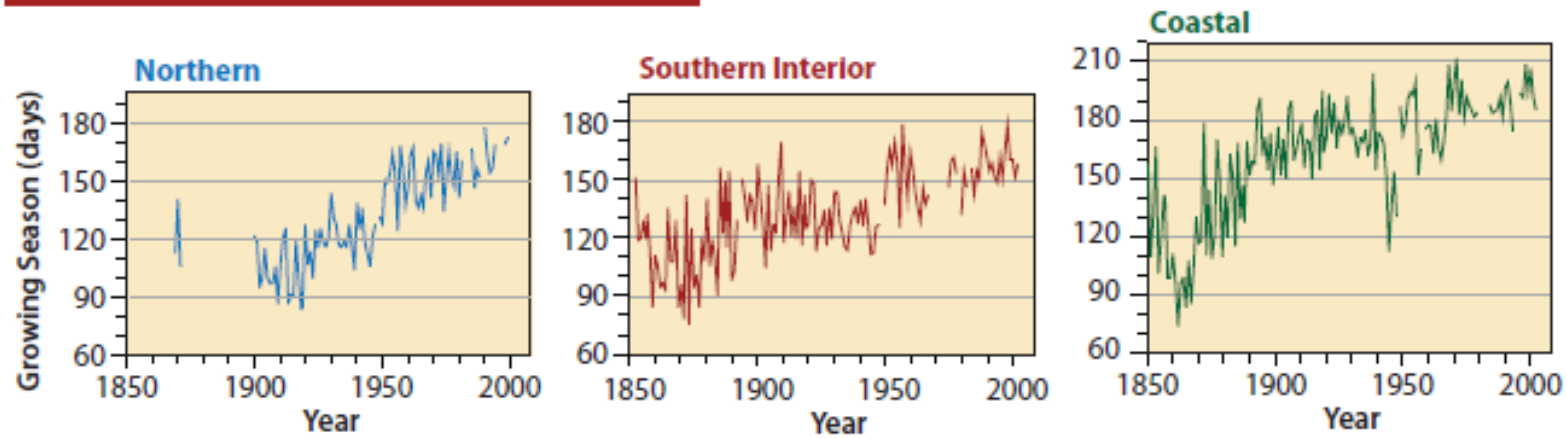


Figure 1 Growing season length in days for each climate division in Maine, based on data from Baron and Smith (1996) and NEISA (2005). Growing seasons were at times much shorter than present, with later frosts in the spring and earlier frosts in the fall.

Maine's Changing Seasons

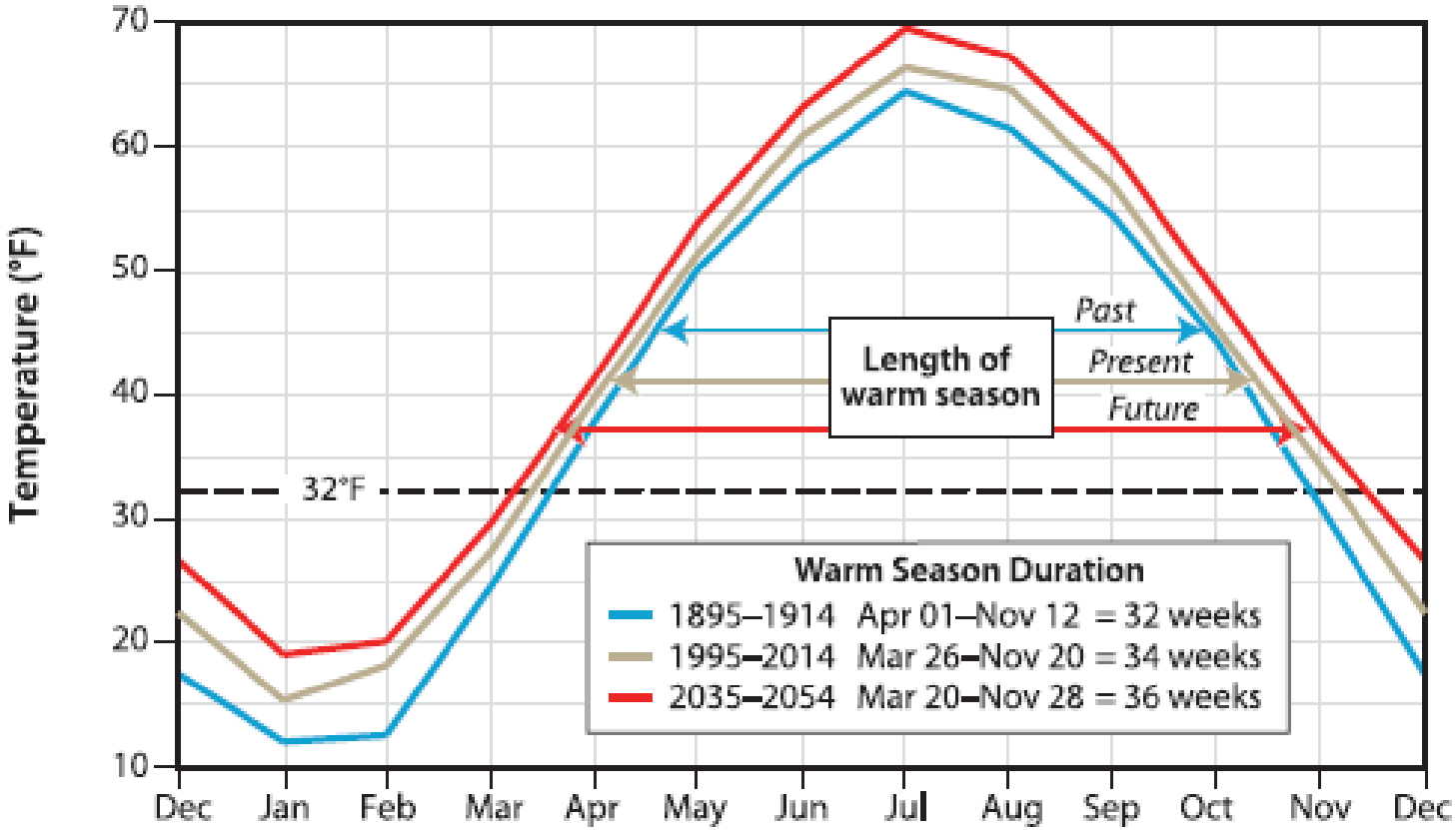
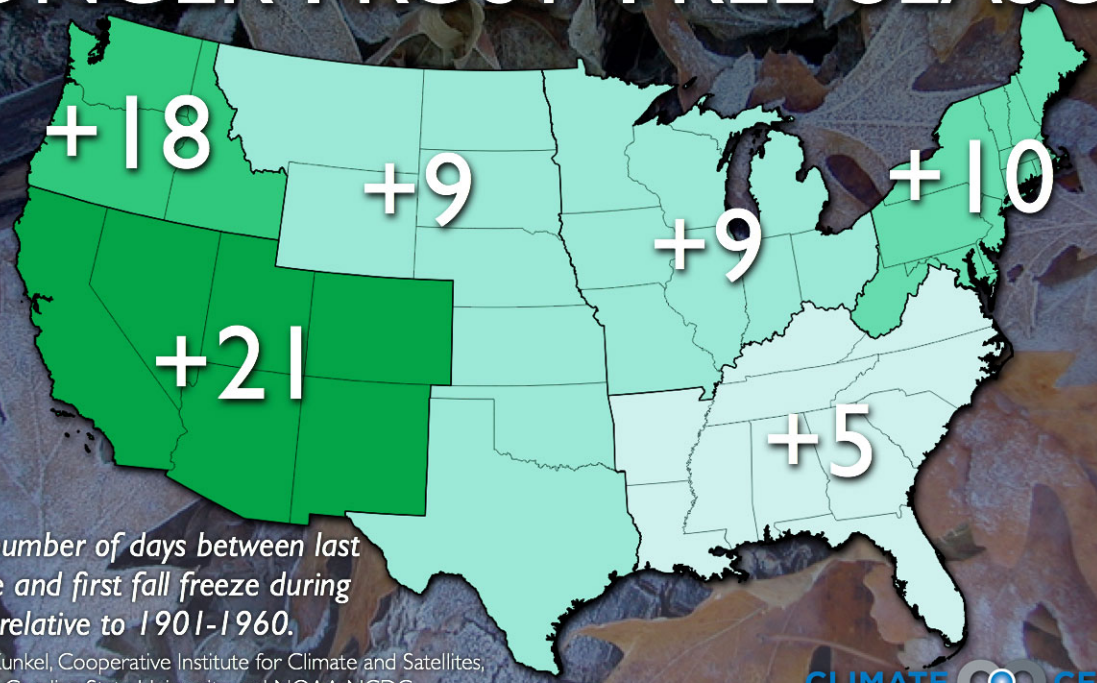


Figure 3. Mean monthly temperature averaged across Maine for historical (1895–1914), recent (1995–2014), and future (2035–2054) time periods. Historical and recent data from the U.S. Climate Divisional Dataset (*ncdc.noaa.gov/monitoring-references/maps/us-climate-divisions.php*), and future prediction from an ensemble simulation of the IPCC emissions scenario A2.

Maine's Climate Future 2015

Longer Frost-Free Season



Increase in number of days between last spring freeze and first fall freeze during 1991-2011 relative to 1901-1960.

Source: Kenneth Kunkel, Cooperative Institute for Climate and Satellites, North Carolina State University and NOAA NCDC

CLIMATE CENTRAL

Ice-out Records for Selected Maine Lakes

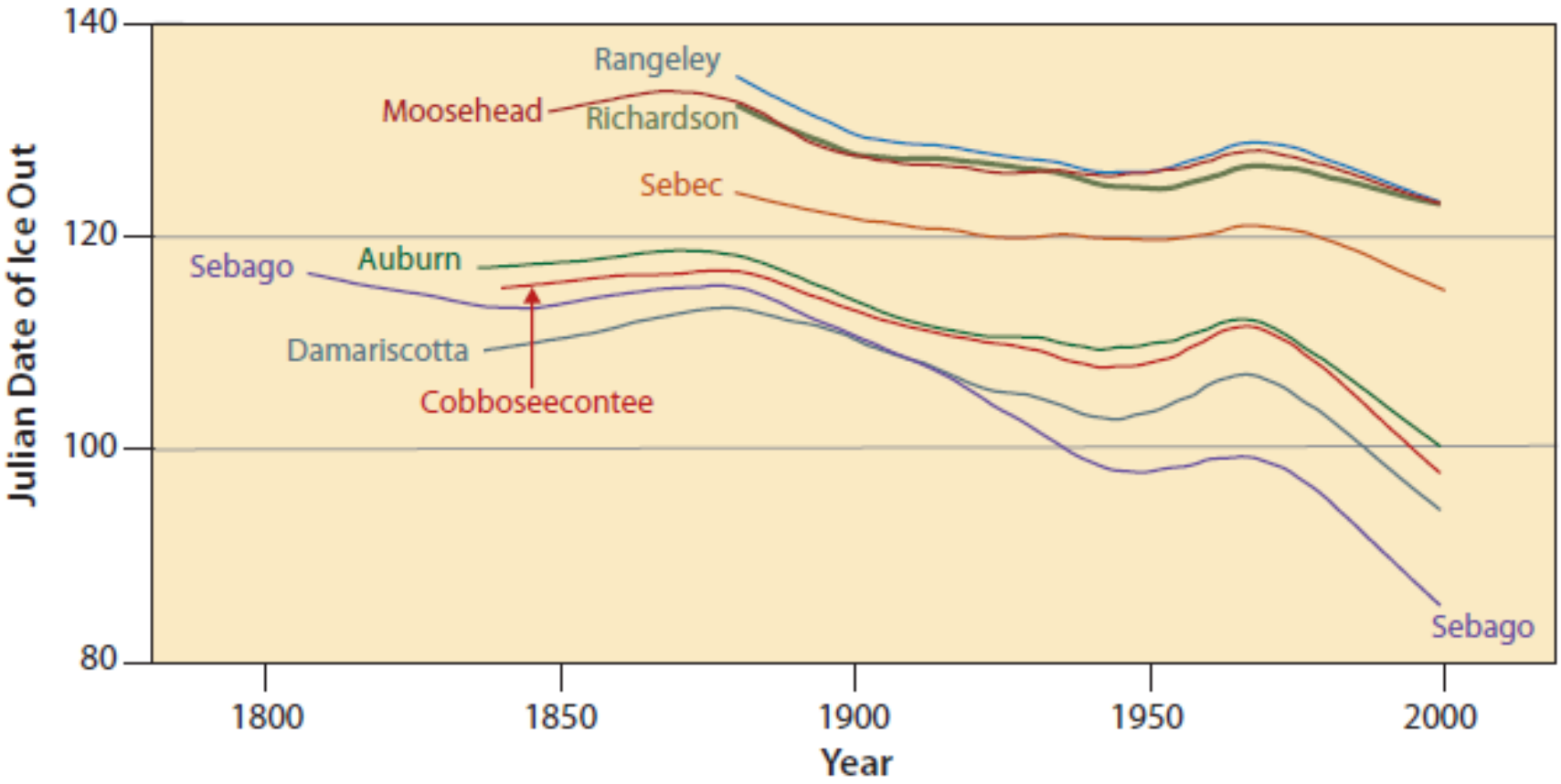


Figure 15b Lake ice-out dates, or the dates of ice break-up, are the annual dates in spring when winter ice cover leaves a lake. Lake ice-out dates in Maine have advanced by up to two weeks since the 1800s (Hodgkins *et al.* 2002).

MAINE'S CLIMATE FUTURE 2009

PLANT HARDINESS ZONES

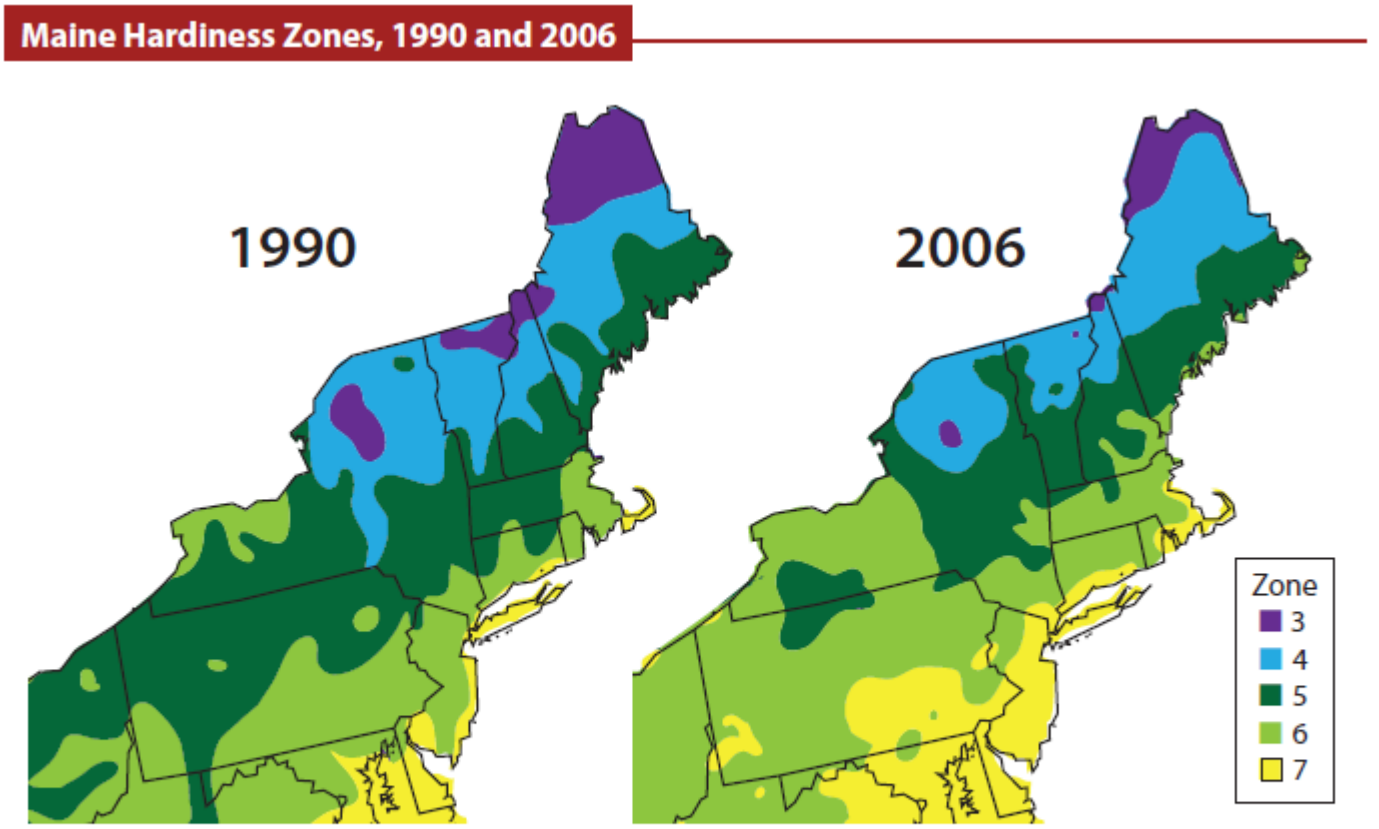
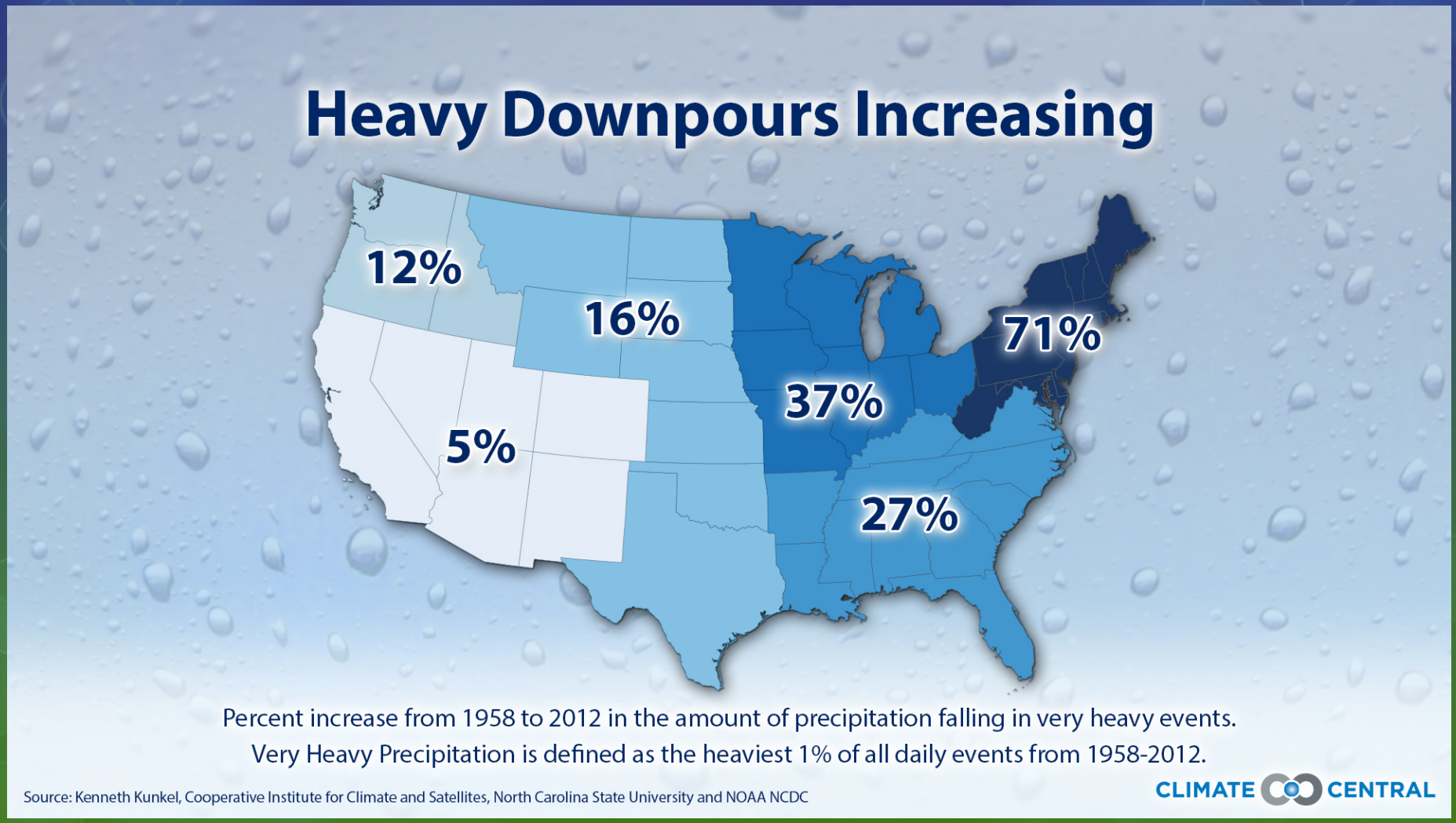


Figure 20 The Arbor Day Foundation (2006) revised plant hardiness zones used by farmers and gardners, based on data from 5,000 National Climatic Data Center cooperative stations across the continental United States. A northward shift in zones reflects a warming climate.

Maine's Climate Future 2009

CHANGING PRECIPITATION AMOUNTS AND TIMING



Maine's Annual Precipitation Present and Future

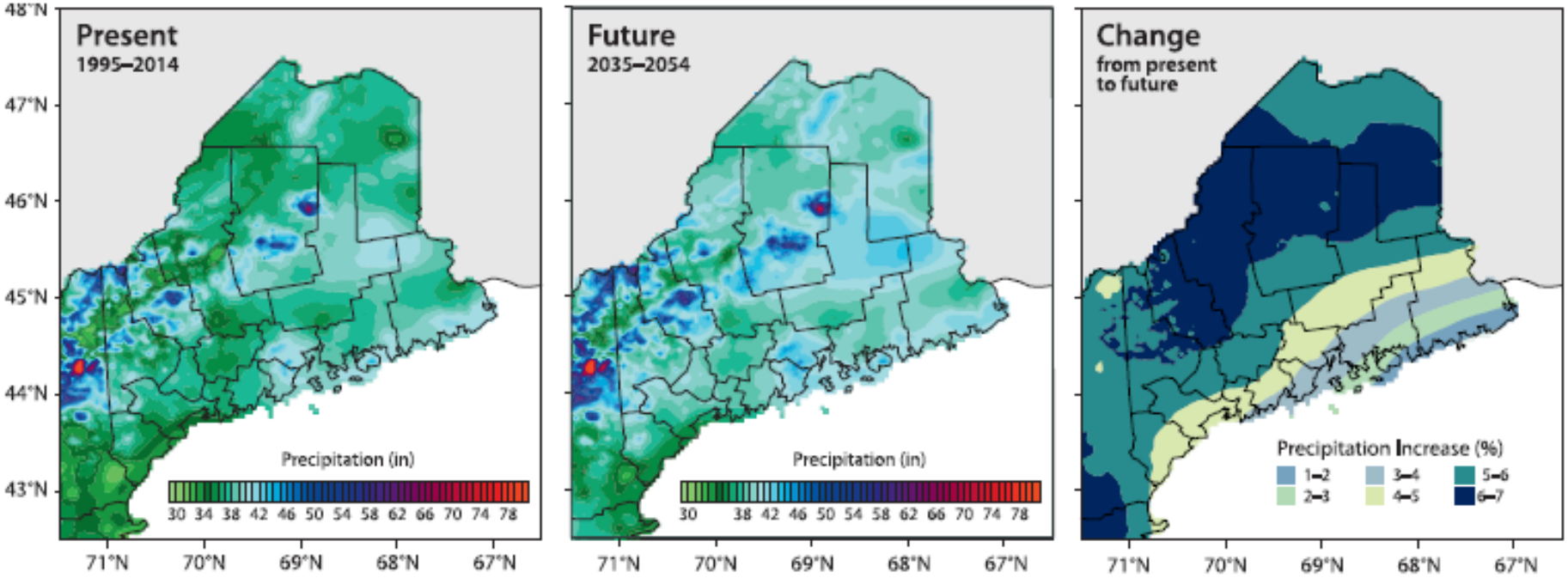
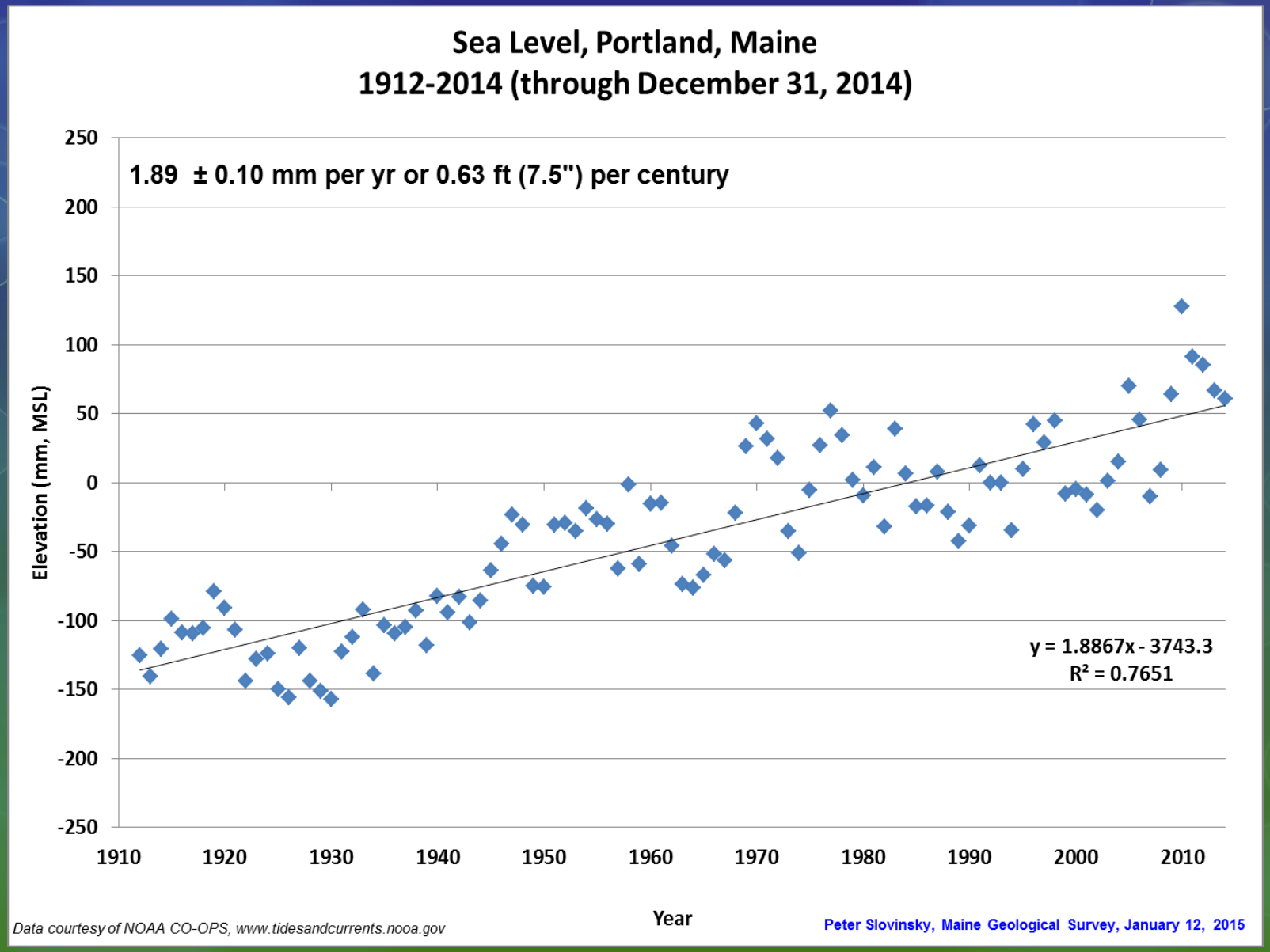


Figure 7. Maps showing total annual precipitation for 1995–2014 (left), 2035–2054 (center), and the predicted change or difference between the two time periods (right). The predicted precipitation increase by 2050 ranges 1–7% from the coast inland to the Canadian border. Maps derived from an ensemble simulation of the IPCC A2 emissions scenario.

Maine's Climate Future 2015

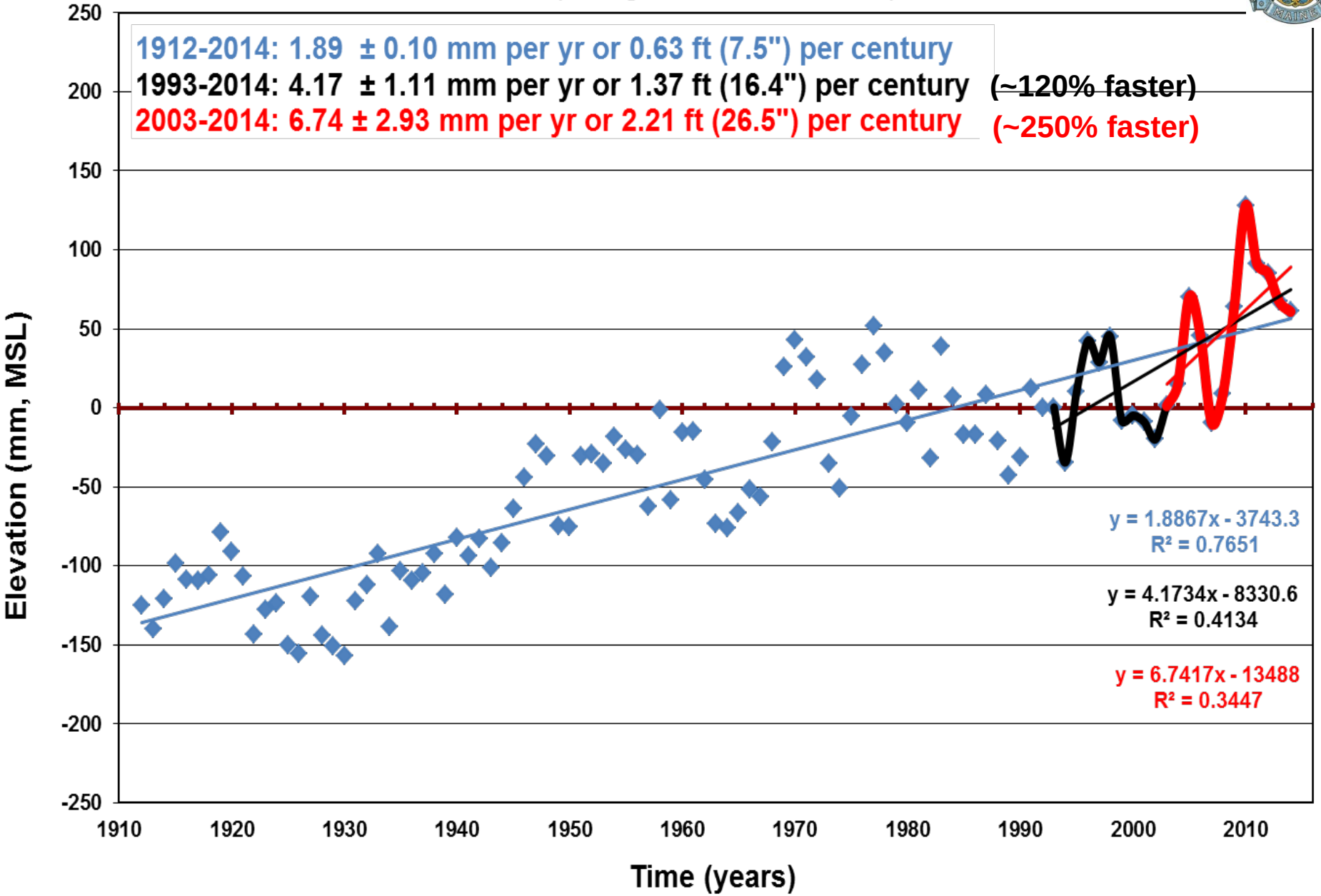
SEA LEVEL RISE



edEx

Sea Level, Portland, Maine

1912-2014 (through December 31, 2014)



Data courtesy of NOAA CO-OPS, www.tidesandcurrents.nooa.gov

P.A. Slovinsky, Maine Geological Survey, January 12, 2015

DEAD
END
NO
DUMPING
OR
LITTERING

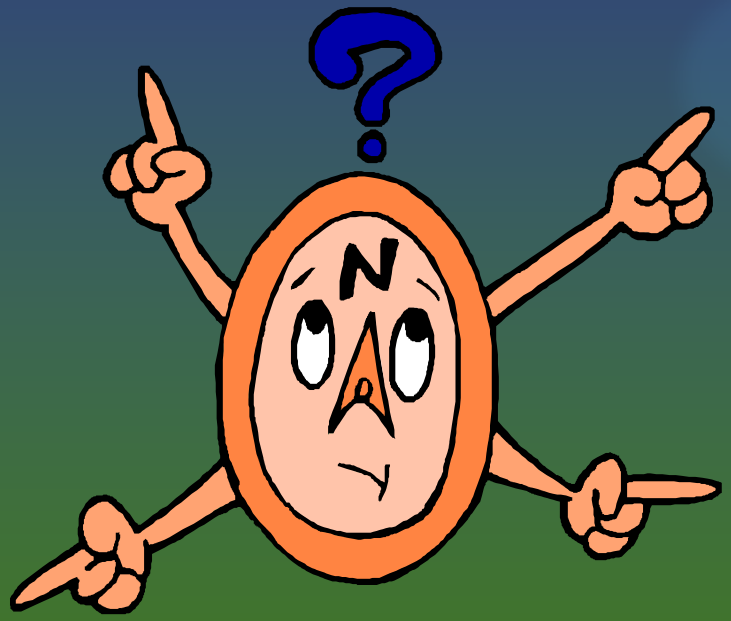
WHAT WE KNOW

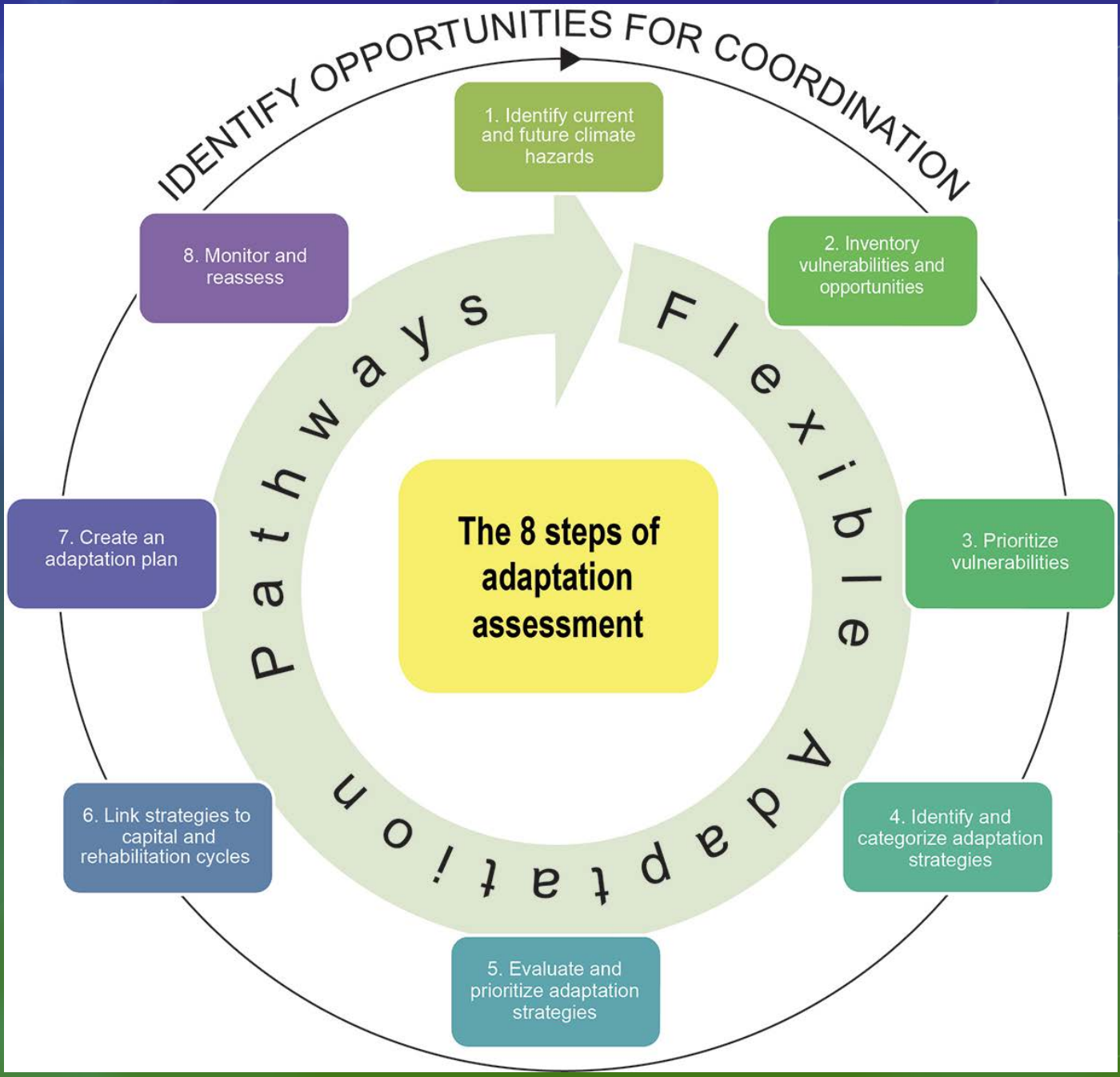
- Maine's average temperature is 3 degrees F warmer than it was 100 years ago.
- Sea levels have risen over the last 100 years and are now rising at an increased rate
- Heavy precipitation, both rain and snow, is happening more often than it used to.

HOW THAT TRANSLATES FOR EMERGENCY PREPAREDNESS

- INCREASED LIKELIHOOD OF FLOODING
- DECREASED WATER QUALITY AS A RESULT OF INCREASED SEDIMENTATION INTO LAKES, STREAMS AND WETLANDS
- CHANGES TO HIGH FLOW AND LOW FLOW PERIODS
- MORE COASTAL EROSION
- INCREASED HIGH HEAT EVENTS

SO, WHAT CAN WE DO?




IDENTIFY OPPORTUNITIES FOR COORDINATION
1. Identify current and future climate hazards
2. Inventory vulnerabilities and opportunities
3. Prioritize vulnerabilities
4. Identify and categorize adaptation strategies
5. Evaluate and prioritize adaptation strategies
6. Link strategies to capital and rehabilitation cycles
7. Create an adaptation plan
8. Monitor and reassess
Pathways
Flexible Adaptation
The 8 steps of adaptation assessment

Adaptation Process

Steps to Resilience:

1. Identify the problem
2. Determine vulnerabilities
3. Establish your risk tolerance
4. Investigate options
5. Take action

IDENTIFY THE PROBLEM

WHICH ASSET
WHICH STRESSOR

ASSESS VULNERABILITY

CURRENT CONDITION
EXPOSURE
CAPACITY TO ADAPT

DETERMINE THE PLANNING HORIZON

SHORT TERM/IMMEDIATE
MAINTENANCE
REPLACEMENT
NEW CONSTRUCTION

ESTABLISH YOUR RISK TOLERANCE

AVERAGE EXPECTED
EXTREME EVENT
SOMEWHERE IN BETWEEN

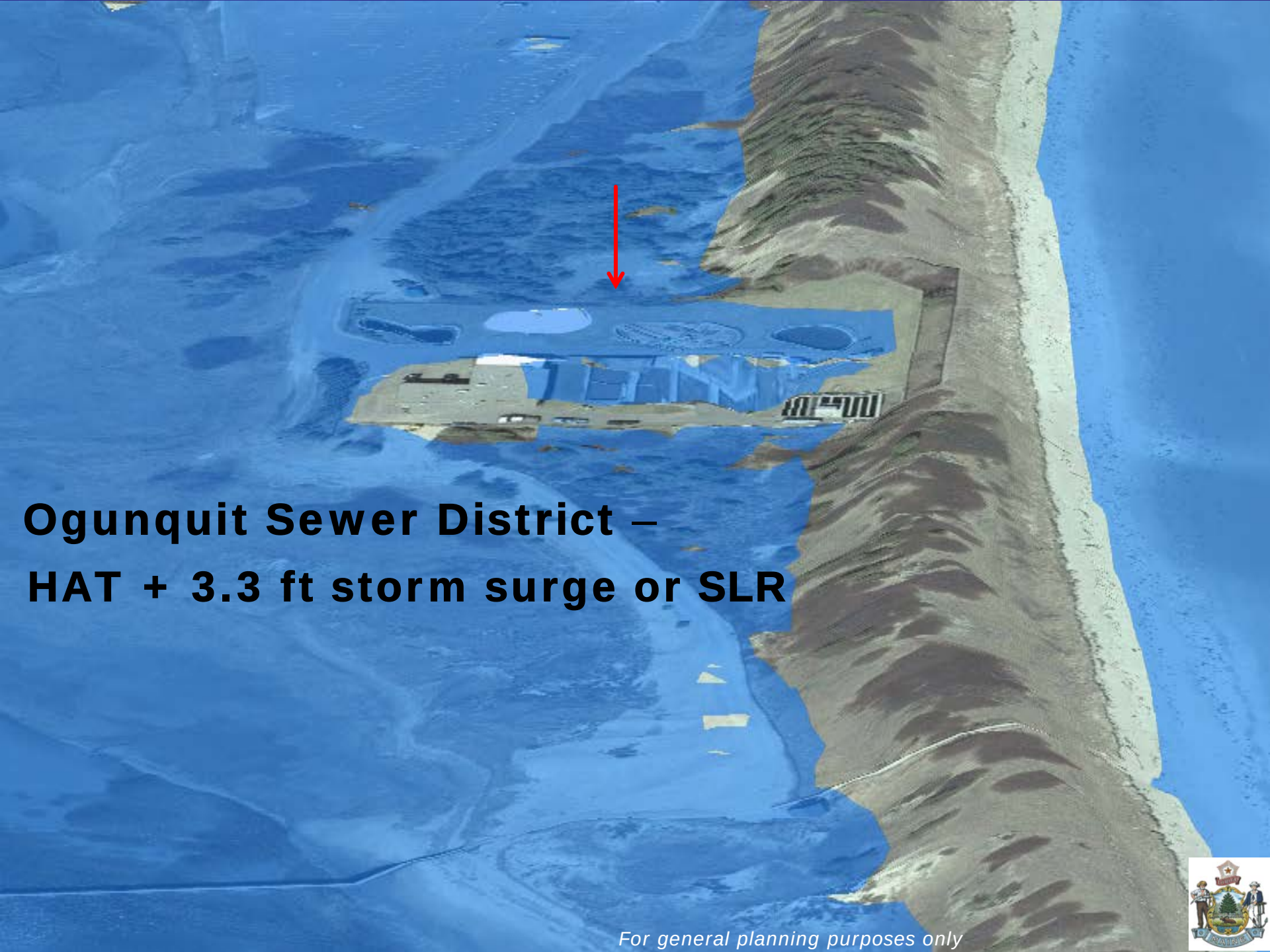
EVALUATE THE OPTIONS

TIMEFRAME
COST
BENEFIT

TAKE ACTION

Adaption: Critical Infrastructure Ogunquit

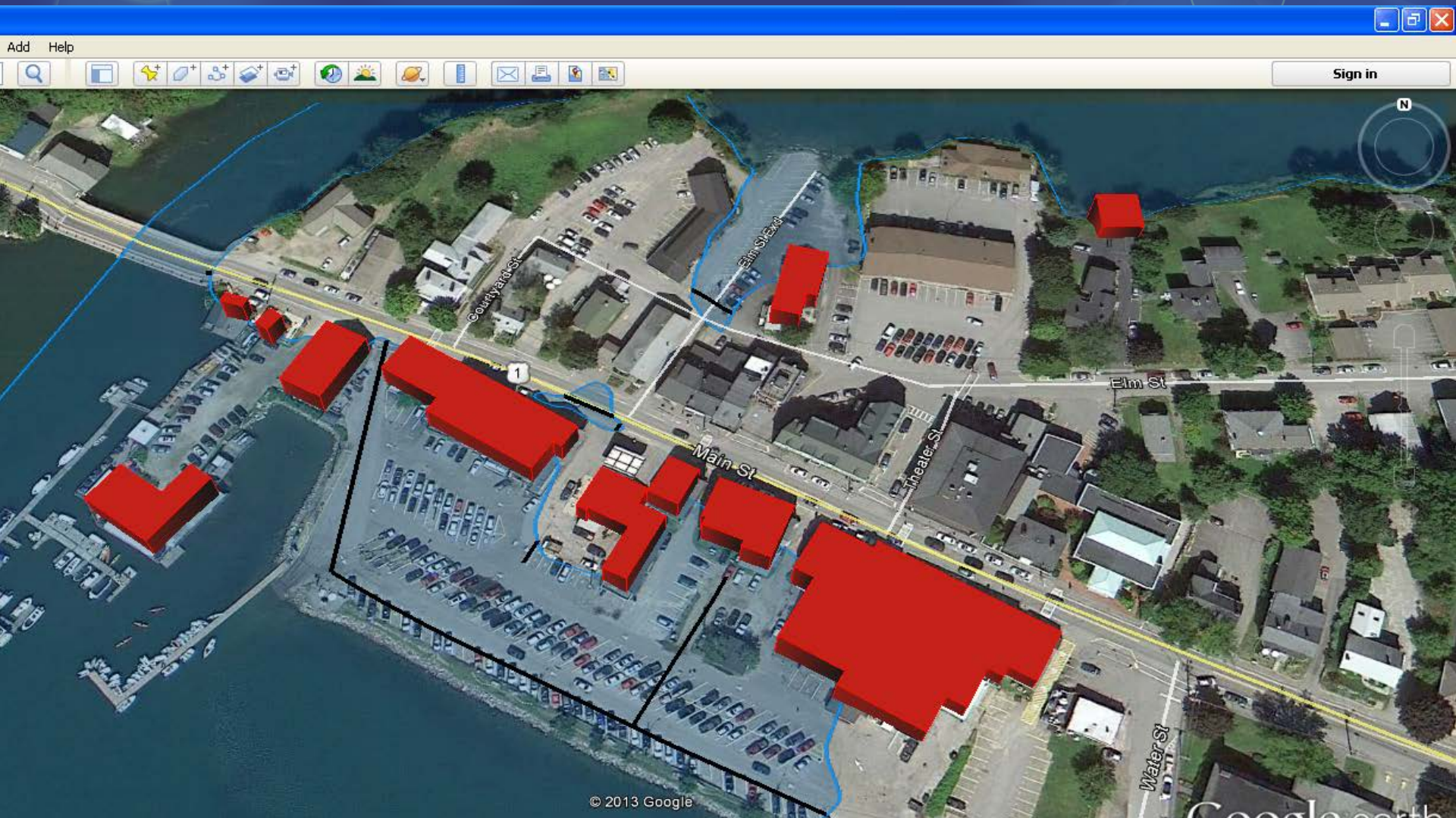
Work by MGS/SMRPC showed a clear risk for the **Ogunquit Sewer District Treatment Plant**



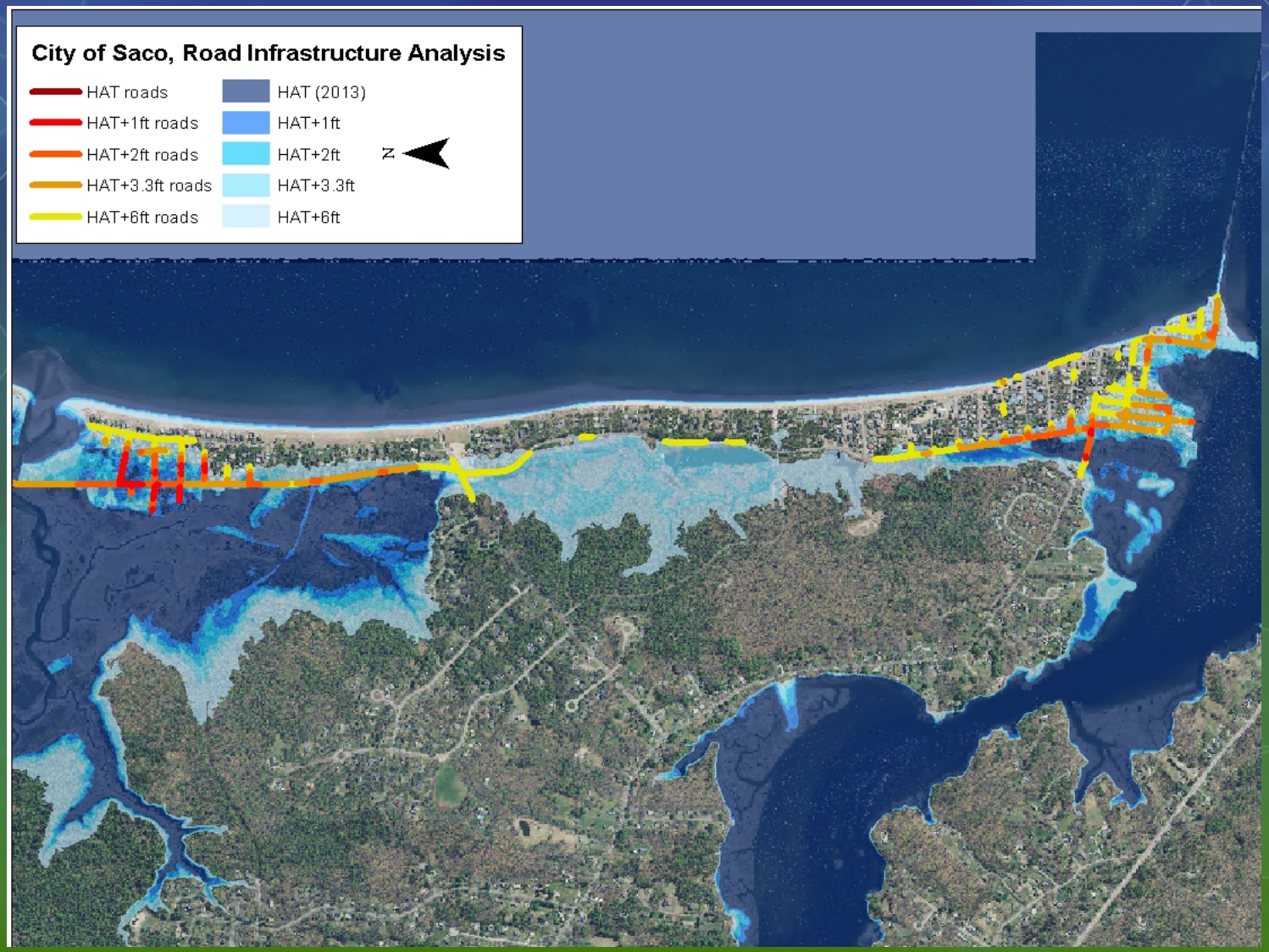
Ogunquit Sewer District – HAT + 3.3 ft storm surge or SLR

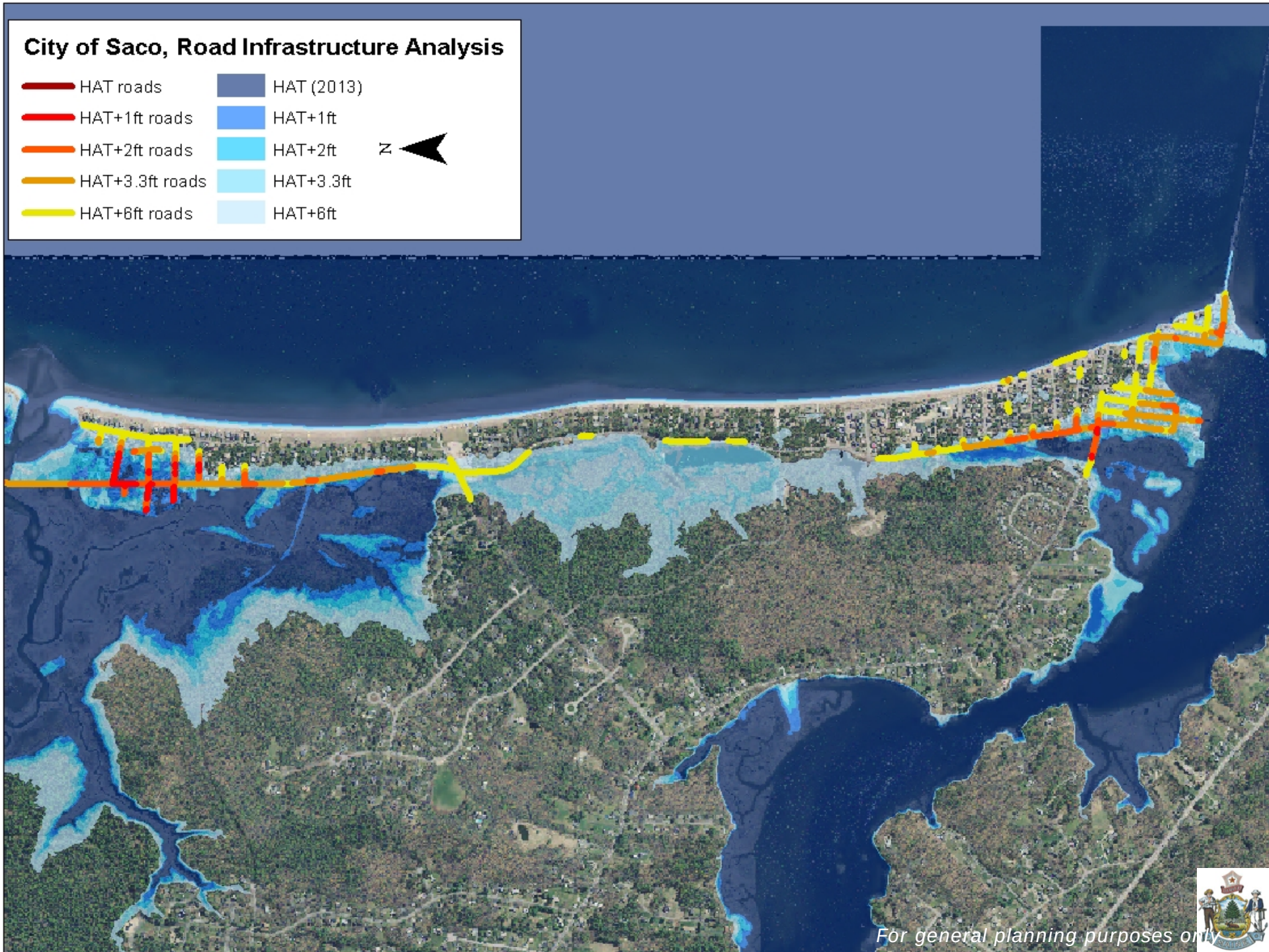
For general planning purposes only

Adaptation for an Historical Downtown: Damariscotta



Adaptation Planning for an Asset Class: Roads




City of Saco, Road Infrastructure Analysis
HAT roads
HAT+1ft roads
HAT+2ft roads
HAT+3.3ft roads
HAT+6ft roads
HAT (2013)
HAT+1ft
HAT+2ft
HAT+3.3ft
HAT+6ft
N
For general planning purposes only

No to some impact	Moderate Impact	Major Impact	Severe Impact
0-50 ft	50-100 ft	100-500 ft	500+ ft

Assessment of Potential Impacts to Roads: City of Saco

Road Name	Road Class	Highest Annual Tide (+ SLR in feet)					1% Storm Event (+ SLR in feet)					Hurricane	
		HAT	HAT+1	HAT+2	HAT+3.3	HAT+6	1%	1%+1	1%+2	1%+3.3	1%+6	Cat1	Cat2
ABBY LN	Local												238
ATLANTIC WY	Local												79
BAY AV	Local			95	378	430	323	380	405	430	430	430	430
BAY VIEW RD	Local					160			91	145	205	157	380
BAYVIEW RD	Major/urb collector					646			372	594	776	602	1277
BEACH AV	Local				86	364	7	87	216	347	364	351	364
BEACON AV	Local			32	66	102	39	66	77	96	419	97	504
CAMP ELLIS AV	Local			183	754	917	222	807	916	916	916	916	916
COTTAGE AV	Local				49	165		52	93	165	165	165	165
COURTLYNN CIR	Local												436
COVE AV	Local				273	594		271	422	559	709	549	709
CURTIS AV	Local				56	187		63	98	167	303	179	335
DUNE AV	Local		43	217	298	347	246	303	328	342	459	347	459
EAGLE AV	Local				26	53		26	38	51	148	54	465
EASTERN AV	Local			54	110	475	63	110	407	458	631	461	631
FAIRHAVEN AV	Local			12	47	177	21	42	65	104	515	87	628
FERRY LN	Local										16		425
FERRY PARK AV	Local					33				25	404	12	595
FERRY RD	Major/urb collector		53	311	313	496	313	311	327	472	823	453	1729
FRONT ST	Local				247	445		211	308	396	490	482	599
HARRIMAN FARM	Local												149
ISLAND VIEW AV	Local					90			69	84	276	84	331
ISLAND VIEW ST	Local					111				37	350	40	455
KING AV	Local										174		365
LANDING RD	Local												1103
LIGHTHOUSE LN	Local										46		221
LOWER BEACH RD	Local			79	135	365	98	140	186	355	632	346	877

** or entire road*

Using existing tools to increase resilience:

Comprehensive Plan : York, Bowdoinham, South Portland

Flood Plain Ordinance: Saco, South Berwick

Shoreland Zoning Ordinance: Cape Elizabeth

Resiliency Strategy: Incorporating more freeboard into municipal floodplain ordinances to account for storms or increased SLR

The City of Saco made ordinance changes to increase freeboard to <u>three feet</u> above the 100-year Base Flood Elevation (BFE). Also done in South Berwick.

Other adaptation planning underway

Lincoln County-wide slr vulnerability assessment and engagement of emergency management personnel

Warren engineering design for three culverts to increase flood resilience and fish passage

Ellsworth assessing stormwater structures for location, condition, capacity

Stonington Harbor vulnerability assessment

Georgetown vulnerability assessment

CHALLENGES AND OPPORTUNITIES

WE EXPECT THINGS TO STAY THE SAME
THE NEW NORMAL INCLUDESLESS CERTAINTY
AND MORE VARIABILITY

THERE IS NO MAGIC NUMBER
MODELS ARE GOOD BUT NOT CRYSTAL BALLS

ADAPTATION WILL NOT BE A ONE TIME THING
MONITORING, RE-EVALUATING, AND UPDATING
ASSUMPTIONS NEED TO BE PART OF THE PROCESS

RESILIENCE AND ADAPTATION WILL PROVIDE ENORMOUS
ECONOMIC AND INNOVATION OPPORTUNITIES