Evidence for a Changing Physical and Chemical Climate in Maine

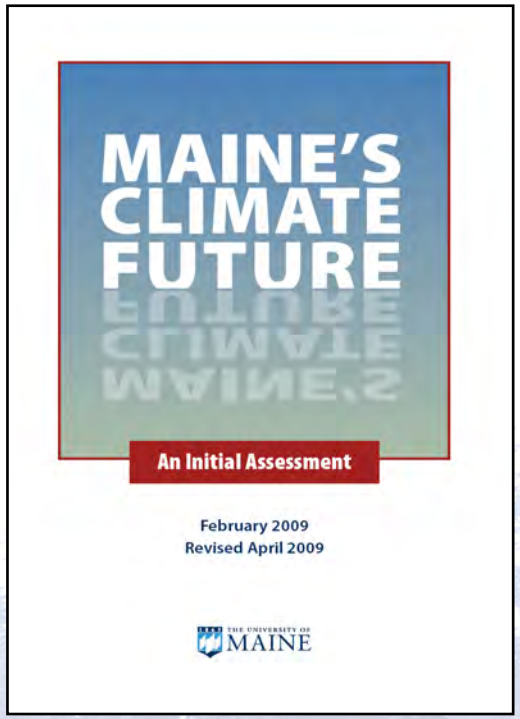
Dr. Ivan J. Fernandez

School of Forest Resources
Climate Change Institute
School of Food and Agriculture


1990
CLIMATE CHANGE
The IPCC Scientific Assessment
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
CLIMATE CHANGE 1995
The Science of Climat
Contribution of Working
to the Second Assessment Re
Intergovernmental Panel on Cli
Climate Change 2001
The Scientific Ba
CLIMATE CHANGE 2007
THE PHYSICAL SCIENCE
Working Group I Contribution to the Fourth Assess
Report of the Intergovernmental Panel on Climate Cl
ipcc
INTERGOVERNMENTAL PANEL ON climate change
CLIMATE CHANGE 2013
The Physical Science Basis
Summary for Policymakers
WG I
WORKING GROUP I CONTRIBUTION TO THE
FIFTH ASSESSMENT REPORT OF THE
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
WMO
UNEP
2018
ipcc
INTERGOVERNMENTAL PANEL ON climate change
Global Warming of 1.5°C
An IPCC Special Report on the impacts of global warming of 1.5°C
above pre-industrial levels and related global greenhouse gas emission pathways,
in the context of strengthening the global response to the threat of climate change,
sustainable development, and efforts to eradicate poverty
Summary for Policymakers
WG I
WG II
WG III
WMO
UNEP

Global

2009


MAINE'S CLIMATE FUTURE
An Initial Assessment
February 2009
Revised April 2009
THE UNIVERSITY OF MAINE

2015


THE UNIVERSITY OF MAINE
MAINE'S CLIMATE FUTURE
2015
UPDATE

Maine's Climate Future Dashboard

	Last 100 years	By ≈2050
Air Temperatures	+3°F	+1-3°F
Warm Season	+2 wks	+2 wks
High Heat Index Days/Yr	0-5	1-15 (more coastal)
Precipitation	+13%	+5-10%
Snow	-7%	-20 to -40%
Ocean Temperature	+0.01°F/Yr	+0.41°F/Yr (>99% world)
Sea Level Rise	+0.62 ft.	+0.5 to 2 ft. (3 ft. or >>!)

Maine's Average Annual Temperature

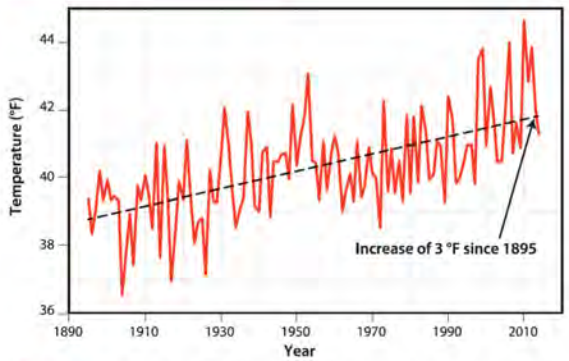
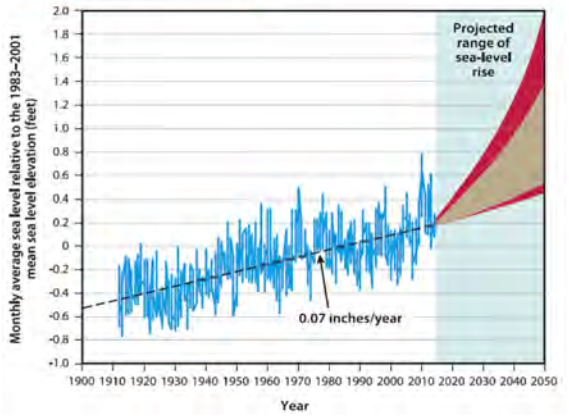


Figure 1. Mean annual temperature, 1895–2014, averaged across Maine from gridded monthly station records from the U.S. Climate Divisional Dataset (*ncdc.noaa.gov/monitoring-references/maps/us-climate-divisions.php*). A simplified linear trend (black line) indicates that temperature increased 3 °F over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

Sea Level Trend at Portland, Maine



Gulf of Maine Sea Surface Temperature

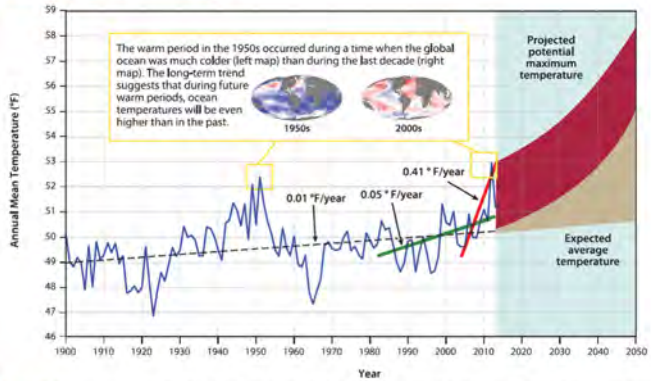


Figure 12. Mean sea surface temperature in the Gulf of Maine from 1900 to 2014 (blue), based on Extended Reconstructed Sea Surface Temperature (ERSST) version 3b data provided by the NOAA/OAR/Earth System Research Laboratory Physical Sciences Division, Boulder, CO (*esrl.noaa.gov/psd/*). The temperature trend over the entire record is 0.01 °F per year (black line). The rate accelerated to 0.05 °F per year after 1982 (green line) and was 0.41 °F per year from 2004–2013 (red line), based on NOAA Optimum Interpolation ¼ degree daily sea surface temperature analysis (*ncdc.noaa.gov/sst/*). Climate models provide a range of estimates of future mean temperatures (red and tan area), with the range driven by the uncertainty in how much carbon dioxide and methane will be added to the atmosphere.[1]

Maine's Total Annual Precipitation

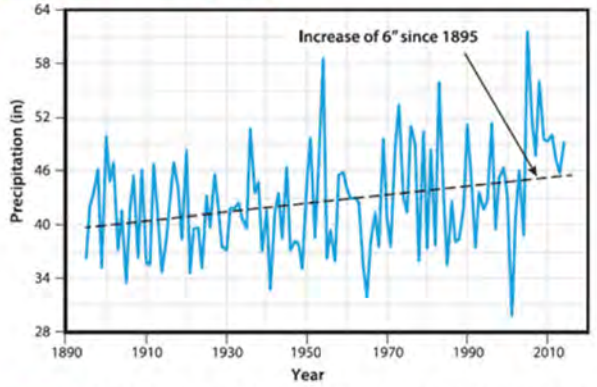


Figure 6. Total annual precipitation, 1895–2014, averaged across Maine from gridded monthly station records from the U.S. Climate Divisional Dataset (*ncdc.noaa.gov/monitoring-references/maps/us-climate-divisions.php*). A simplified linear trend (black line) indicates that precipitation increased six inches, or about 13%, during the recording interval.

Projected Snowfall Decline

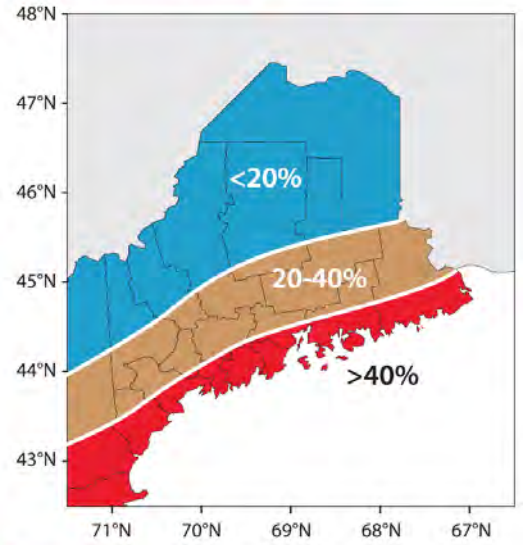
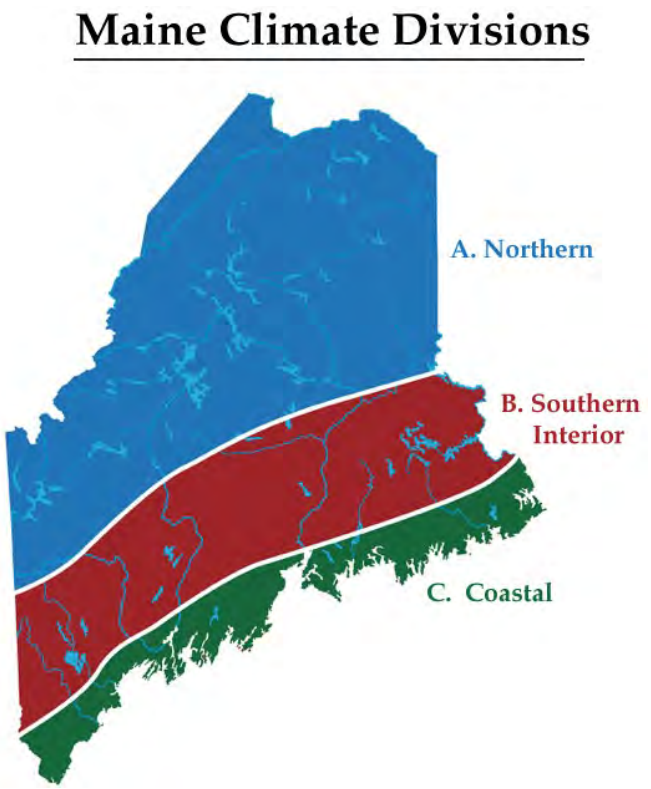
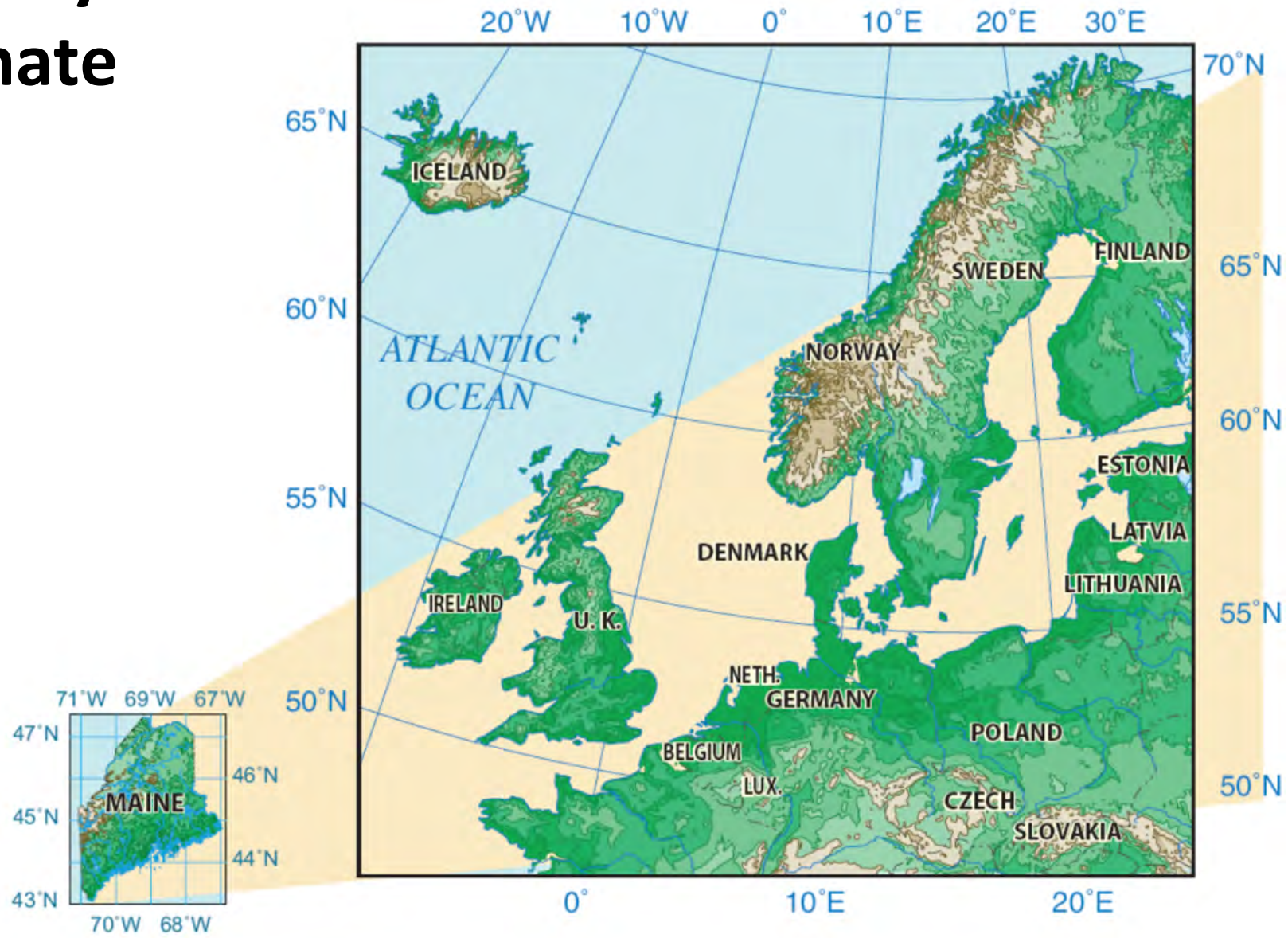


Figure 10. Map showing the predicted change or difference in total accumulated winter snow by climate zone from 1995–2014 to 2035–2054. The greatest changes are predicted to be along the coast, where many winters of the future will bring rain instead of snow. Map derived from an ensemble simulation of the IPCC A2 emissions scenario.

Fernandez et al. 2015

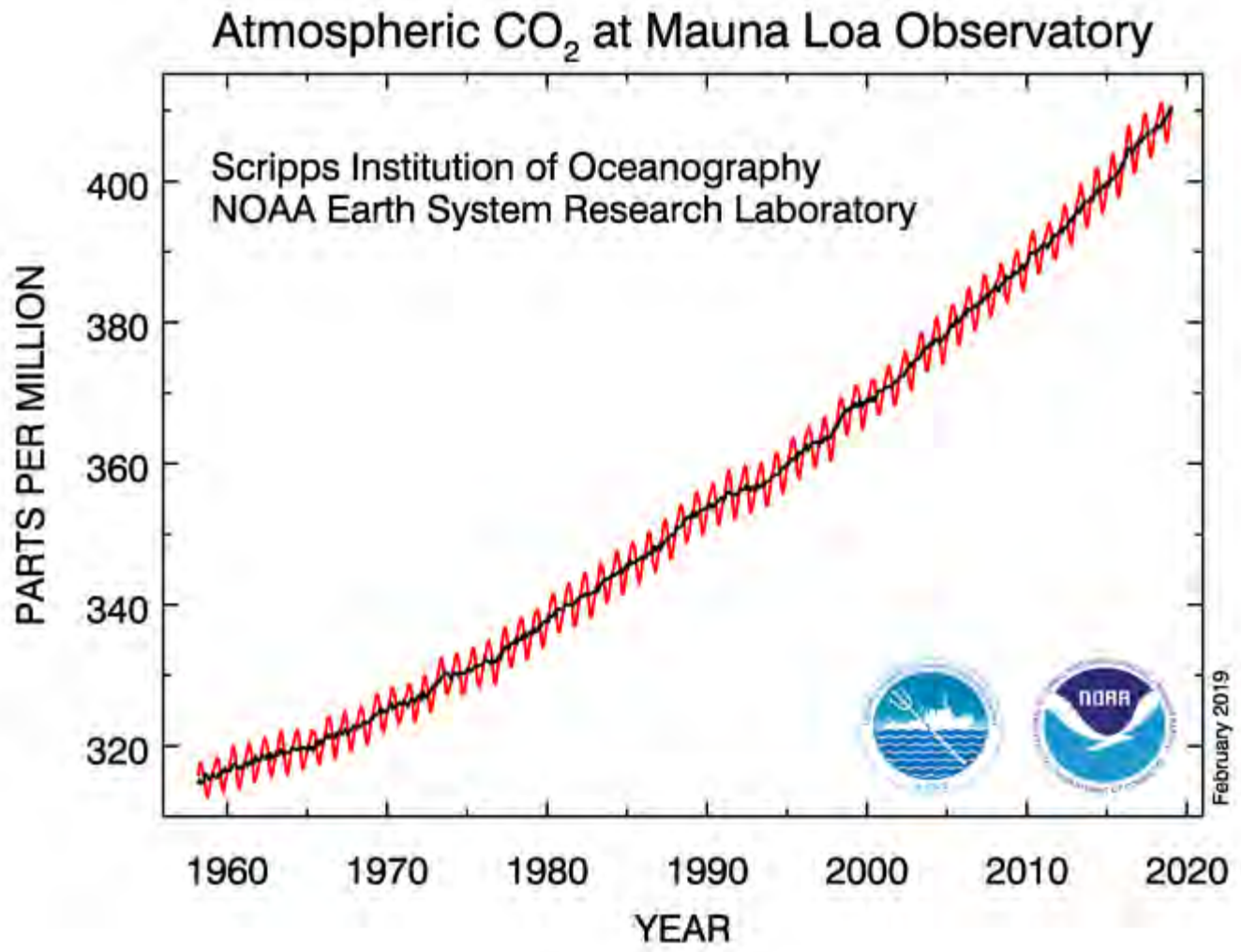
Temporal *and* Spatial Variability in Maine's Climate





Jacobson et al. 2015

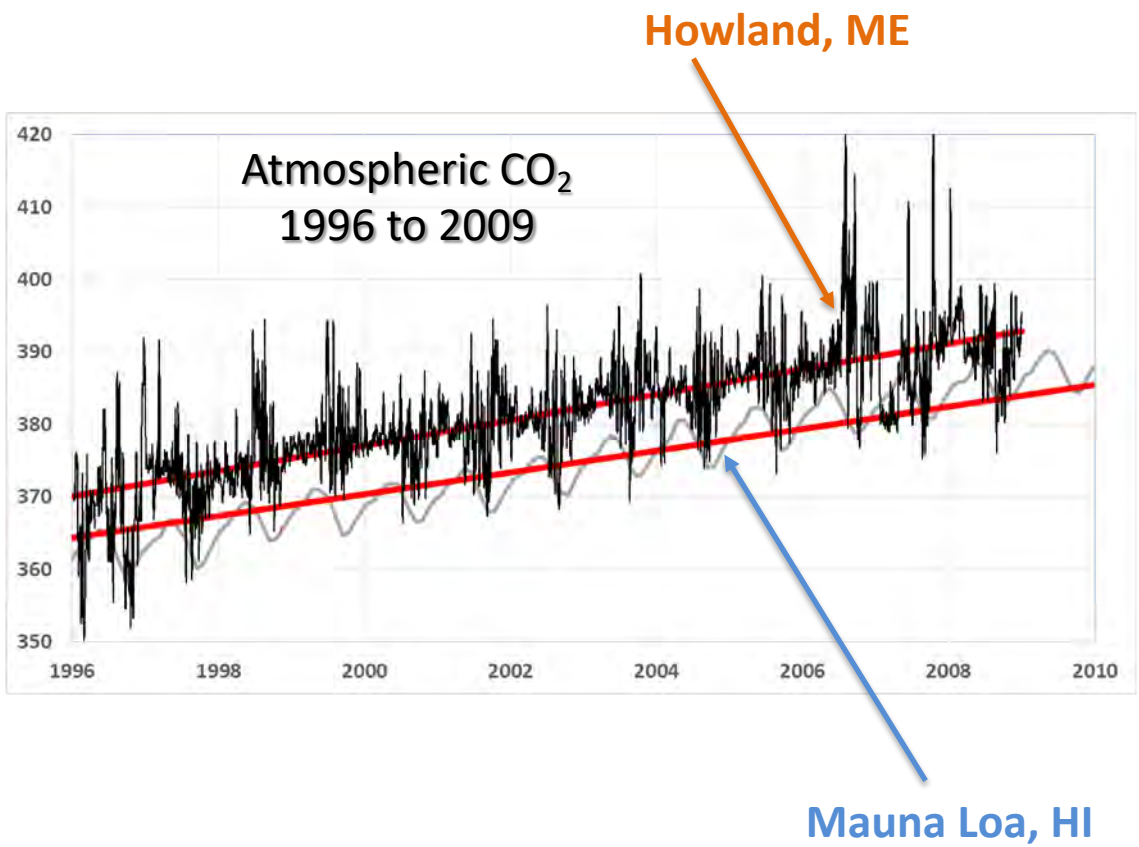
This is from Hawaii, which is NOT in Maine!

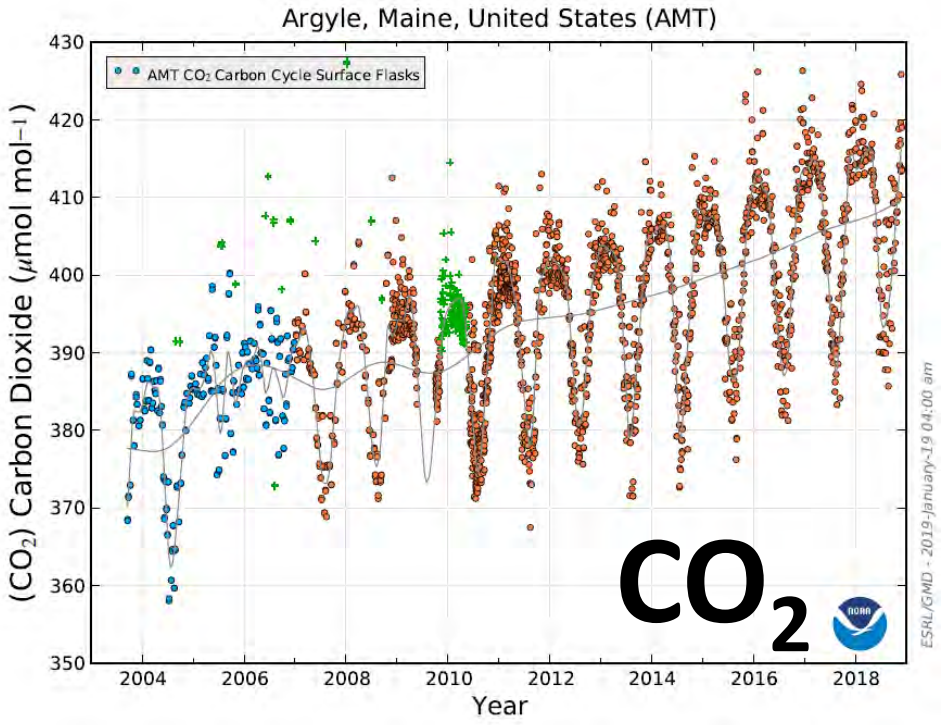


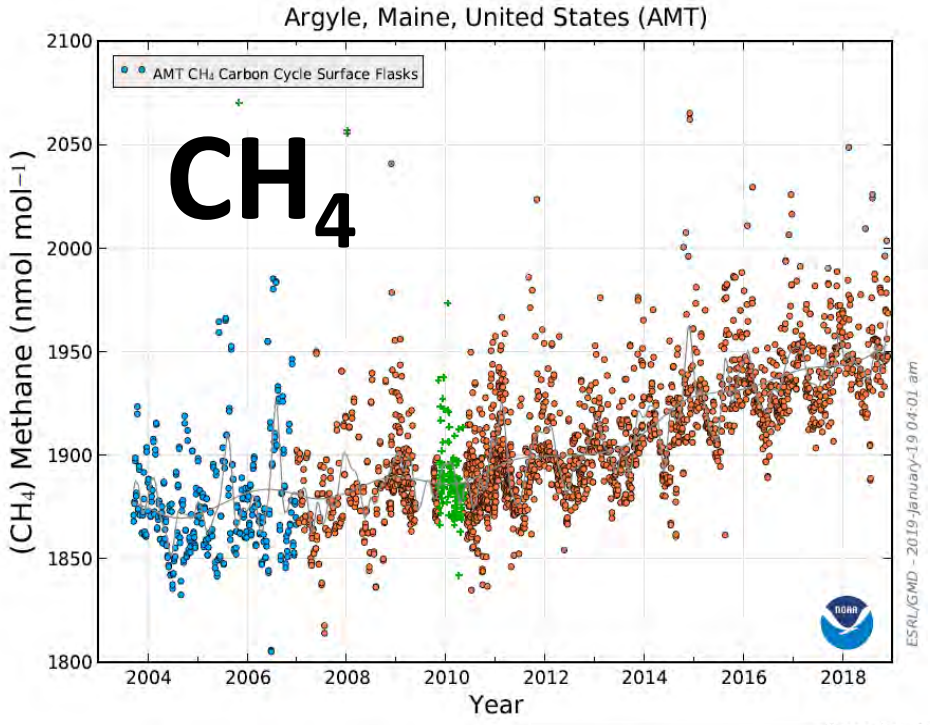
"The Keeling Curve"

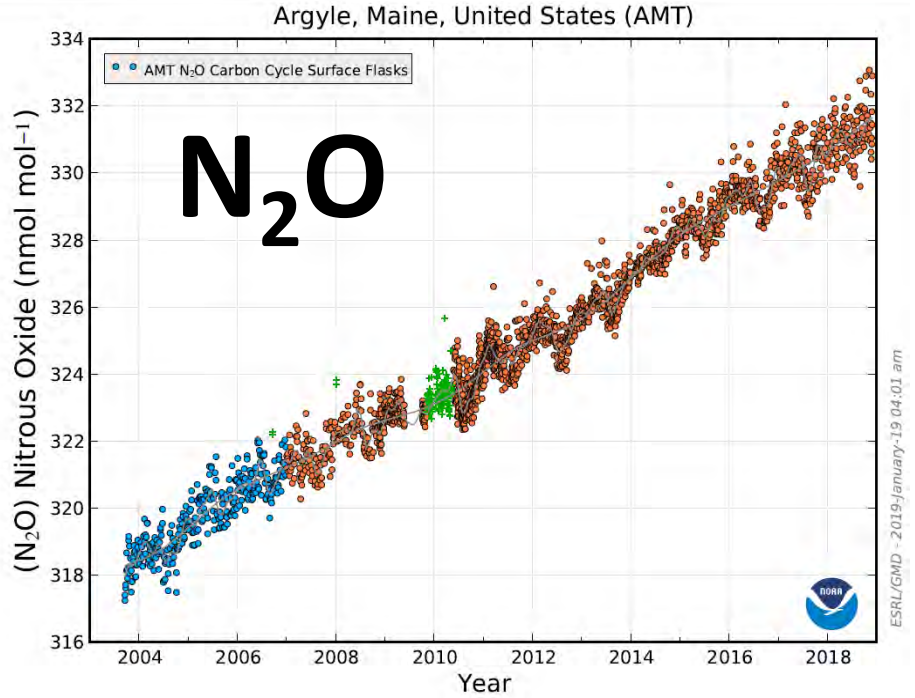
http://www.esrl.noaa.gov/gmd/ccgg/trends/

Maine Has Rising Atmospheric CO_2



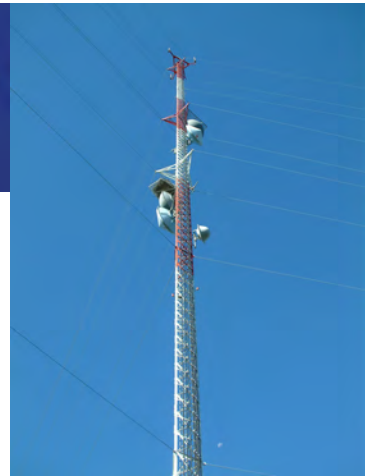






Earth System Research Laboratory
Global Monitoring Division

ESRL GMD Tall Towers Site
Argyle, Maine (AMT)

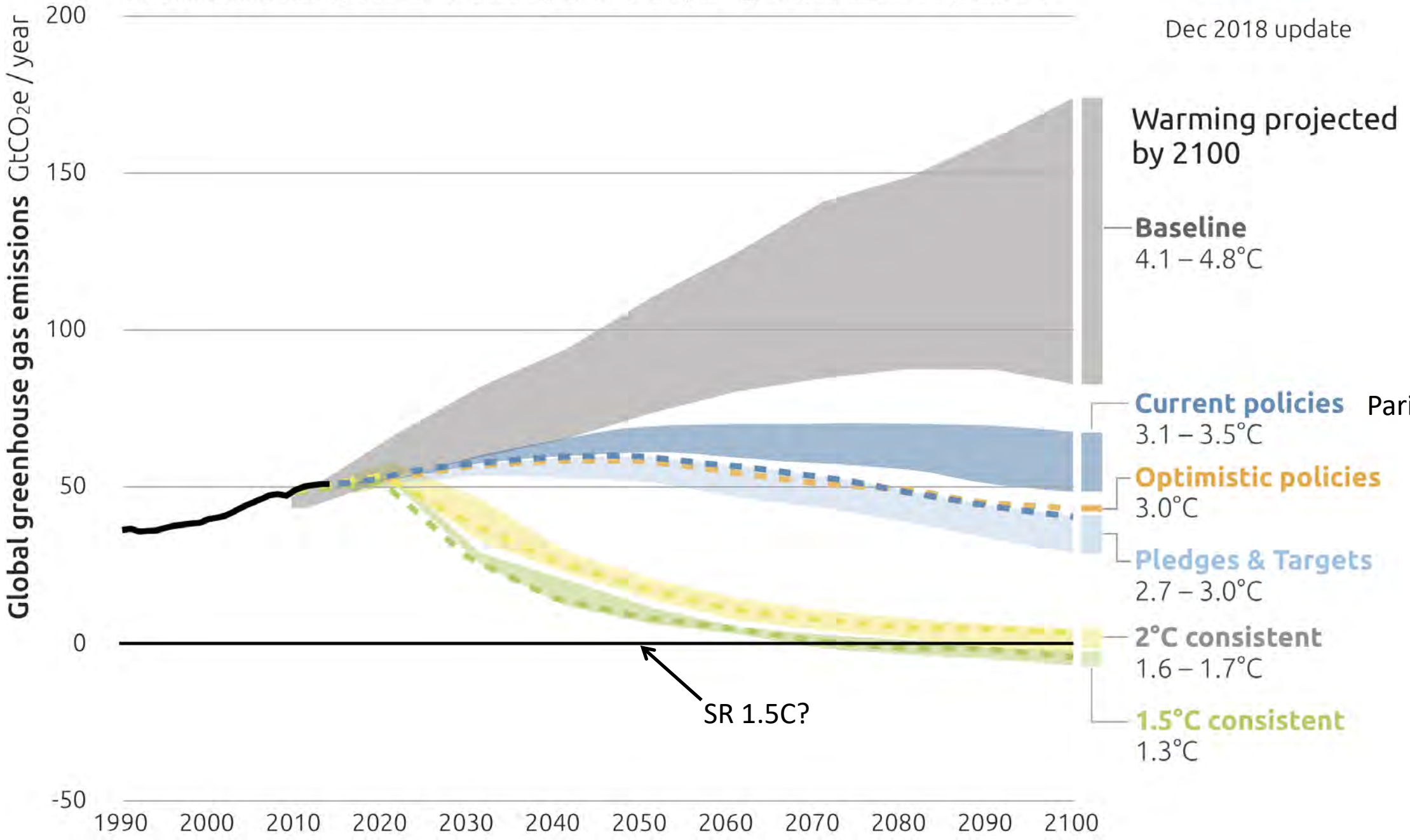


2100 WARMING PROJECTIONS

Emissions and expected warming based on pledges and current policies

Climate Action Tracker

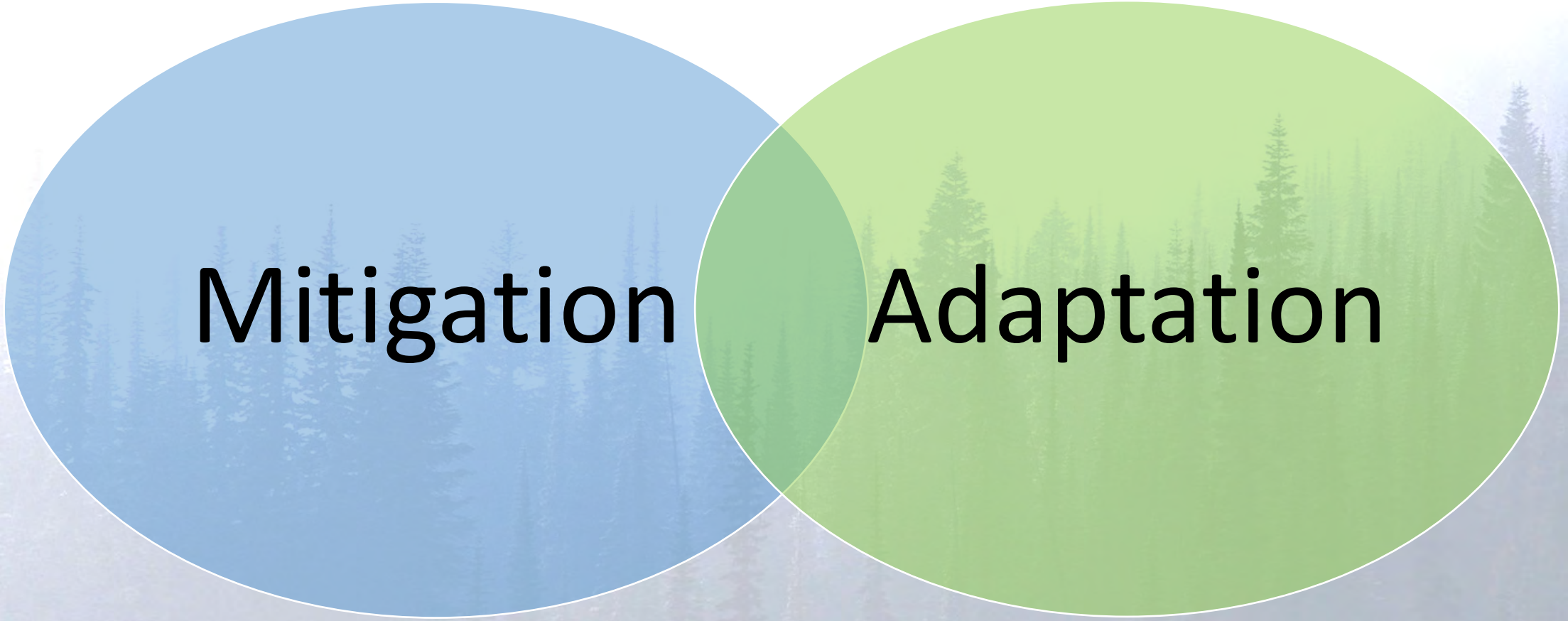
Dec 2018 update



Paris ~3 C?

https://climateactiontracker.org/media/images/CAT-2100WarmingProjections-2018.12.original.png

Forest Resources and Climate Change



Question/Comments

Center for Research on Sustainable Forests

5755 Nutting Hall, Room 263

Orono, ME 04469-5755

Tel: 207.581.3794

Fax: 207.581.2833

crsf@maine.edu

https://crsf.umaine.edu/forest-climate-change-initiative/